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National Works Visits

It is now possible to assess the worth of the National Works Visits organized annually by the Institute of British Foundrymen. This event was originated by Mr. R. B. Templeton during his presidency in 1948-49. The objectives underlying the scheme were (1) that an opportunity would be afforded for visits by those who must "hold the fort" whilst their chiefs participate in the annual conference of the Institute; (2) hotel accommodation in the large industrial centres is now so limited that, *force majeure*, full-scale conferences tend to migrate to spas and seaside resorts somewhat removed from centres of major foundry activity—a restriction which does not apply to lesser functions—and (3) founders located in areas remote from those where Institute branches are established are provided with an opportunity to visit a group of works otherwise denied to them and to meet their opposite numbers in a semi-social atmosphere.

This is an improvement on a good system operated before the war by the London branch of inviting (with an eye on reciprocal treatment!) a provincial section to join them in a works visit and a social evening. The new system is devoid of restrictions and gives a wide choice of visits. The first city to open its foundries was Birmingham, followed by London, and this year the South Wales area was selected. So far, a total of 36 establishments have been inspected by about 580 members. The industry should be, and undoubtedly is, grateful to these firms for so generously opening their premises for inspection. There are about eight more centres worth visiting, and by the time they have all contributed to the scheme, Birmingham will be ripe for re-visiting.

We have very often been concerned when attending foundry conferences, both here and especially on the Continent, at the absence of young executives. We recall participating in a social function at one of the branches of the Institute and there did not appear to be one member present under forty years of age. It is therefore very pleasing to notice from the many photographs of the visitors to the various works available to us that the younger men predominate. Mr. Templeton can now have the satisfaction of seeing his scheme fructify and achieve outstanding success. The scheme is so well founded that it can be commended without reservation to other national technical associations concerned with the notion of giving added service to their members.

CYRIL J. DADSWELL

President of the Institute of British Foundrymen.

Leaders of the Industry

DR. C. J. DADSWELL

CYRIL J. DADSWELL, Ph.D., B.Sc.(Eng.), *Ingénieur E.S.F.*, M.I.Mech.E., director of English Steel Corporation, Limited, is so well known to readers as this year's president of the Institute of British Foundrymen as to need no repetition in this context of the details of his outstanding career. It is always fascinating, however, to go behind the scenes a little and find how a prominent personality has climbed the ladder to success. The most important early interests, Dr. Dadswell owes to his father, who, as a mechanical engineer, saw that he did part-time apprenticeship in the family engineering works at the same time as he was studying at Brighton Technical College. From that time, it was always the president's ambition to apply himself to works management.

It may be that an early interest in mathematics was an indication then of the analytical mind which later became so useful in developing foundry processes at a time when steelfoundry methods were still very much rule-of-thumb. The steel foundry of English Steel Corporation, Limited, under his management was one of the first to have foundry planning and process sections. On the management side, an interest in handling and production methods came no doubt from the engineering background which had been further fostered by a spell in a Carriage and Wagon works, where mass-production methods had just been introduced.

Becoming interested in foundrywork, a strong ambition to see methods abroad led to the achievement of a travelling fellowship and opportunity to study in France at the *Ecole Supérieure de Fonderie*. and later, when in a managerial position, to a visit to America for a lengthy period. American methods were absorbed and applied in this country in the technique of making certain steel castings before any other steel foundry. In particular, the E.S.C. steel foundry was one of the earliest of British steel foundries to make large quantities of sizeable green-sand moulded castings. Having made an established success of foundry management, his engineering background again enabled him to reach his high executive position in English Steel Corporation, Limited, which firm has a very wide variety of products, all different from the foundry, such as the manufacture of drop-forgings, springs and so on. Behind this modest account, the charming personality and qualities of clear and swift analytical appraisal have no doubt contributed much to make the president's life one of the outstanding success stories of our industry.

Dr. Dadswell is a member of the executive of the British Steel Founders' Association, and chairman of the Lancashire and Yorkshire region. He is also chairman of the Backup Roll Makers' Association, and vice-chairman of the B.S.F.A. Research and Development Division. He is a member of the Iron and Steel Institute and a Fellow of the Royal Society of Arts. He is also Freeman of the Company of Cutlers in Hallamshire.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

THE WHITE PAPER

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—Many of us who read the letter from Mr. C. H. Kain, published in your issue of October 30, must have experienced some irritation, which I hope you will allow me to express. It is well known that the organization consulted by the Minister was the Joint Iron Council. Mr. Kain must know that the J.I.C. has been wholly supported by its ironfounding partner, the Council of Ironfoundry Associations, and, in turn, it (the C.F.A.) in this matter enjoys the support of a substantial majority of its constituent associations who, also, have consulted and are supported by their members. Thus, the subscription-paying members of those associations are (by a large majority) in favour of the policy which has been adopted.

Mr. Kain should also know that the C.F.A. reached its decision and gave its support entirely independently of the Central Iron Producers. It simply is not the case that the ironfounders " are to be controlled at the behest of the pig-iron producers." In any event, it is difficult to see how the future prospects of pig-iron producers would be improved as a consequence of their " contriving " the inclusion of ironfounders in the Bill.

Admittedly, a minority of ironfounders does not support the policy; ironfounders do not seem to realize that no new controls are being extended whatever; they seem to have forgotten how smoothly the industry functioned under the old Iron and Steel Board, and they seem to overlook the very desirable objective of lifting the iron and steel industry out of the political arena.

Every man is entitled to his own opinion—but is a trade association member entitled to attack his organization in the public Press? Trade association members are generally willing to submit to the majority view and, unlike your correspondent, most of them are unwilling to torpedo their own association when they find themselves in the minority.—Yours, etc.,

T. LEE,
President.

National Ironfounding Employers' Federation,
8, Frederick's Place, Old Jewry, London, E.C.2.

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—Every founder, on the first glance at the White Paper, must appreciate the points brought forward by Mr. Ronald Giles in his letter of October 17. We are all fed up with controls, and the possibility of interference, and direction by an Iron and Steel Board appears to be an unpalatable and unexpected step in further bureaucratic control. And under a Conservative Government!

However, I would ask Mr. Giles to study the possible alternatives to the Bill, and to consider the assurances given by the Minister of Supply in the House on October 22. None of us wants controls, but all of us agree that the economic position of the country demands a control over the purchase of raw materials from abroad, and their fair, efficient distribution within the iron and steel industry.

It must be borne in mind that it is not proposed to give the Iron and Steel Board any important powers not already vested in the Ministry of Supply. If there must be a broad control over the iron and steel industry, is it not better for the foundry industry to have a voice in such control? The constitution of the proposed Board has not been disclosed by the Minister, but it is confidently anticipated that it will include a representative directly associated with the foundry industry. The necessary supplies of pig-iron, scrap, coke, etc., will therefore be safeguarded at the highest level. If the distribution of such materials were controlled by a Board, principally composed of steel interests, supplies might not go in the direction of iron foundries in the tonnages required by Mr. Giles.

There is a general uneasiness in the ironfounding and steelfounding industries that the inclusion of foundries within the ambit of an Iron and Steel Board makes the possibility of nationalization much more imminent if a left-wing Government is returned at the next election. On reflection, I think it will be agreed that, whether foundries are left as separate capitalistic units, or brought within the control of a Board, it will have little influence on a party pledged to nationalize all means of production and distribution. It is completely unrealistic to expect a left-wing Government to overlook such a basic industry as founding in satisfying its unwholesome appetite for nationalization. It could be argued that sand and slag might cause chronic indigestion, but the Labour hierarchy is quite prepared for the country to suffer such discomfort, even as far as the death bed.

A further objection to the Bill is the power of price control vested in the Board, and the fear that this might extend to partly or finished products of the engineering industry. In point of fact, the Ministry of Supply already has such powers, but as was broadly recognized, particularly in war years, such control is extremely difficult to operate. In the recent parliamentary debate, it was also made quite clear by the Minister that he had no intention to interfere in the day-to-day running of the foundry industry.

I appreciate Mr. Giles giving his views. I do not share his fears regarding the effects of the Bill, but he is right in asking founders to give thought to the White Paper. Greater consideration must be given by all of us to political influence on the future of our industry, otherwise we are going to be faced by a small but very hard-working and vocal left-wing minority leading us by the nose.—Yours, etc.,

JAMES BELL.

Somerset House,
Temple Street, Birmingham, 2.

Metallurgy of the Rarer Metals

Last week-end, October 31 to November 2, the Institution of Metallurgists held a refresher course at Ashorne Hill, near Leamington Spa, to cover the metallurgy of the rarer metals. Uranium was dealt with by L. Rotherham, M.Sc.; the platinum group by E. C. Rhodes, B.Sc., Ph.D.; chromium and manganese by E. A. G. Liddiard, M.A.; beryllium by B. A. Scott, B.Sc., Ph.D.; tantalum and niobium by J. C. Chaston, B.Sc., Ph.D.; molybdenum by L. Northcott, Ph.D., D.Sc.; tungsten by I. Jenkins, D.Sc.; and titanium and zirconium by J. W. Rodgers, M.Sc., Ph.D. In due course, all the papers will be published and available to readers on application to the secretary of the Institution, Dr. A. D. Merriman at 4, Grosvenor Gardens, London, S.W.1.

London Branch Dinner/Dance.—Members of the London branch of the Institute of British Foundrymen are urged to make early application for tickets and table reservations for the annual dinner/dance to be held at the Café Royal, Regent Street, London, W.1, on Friday, November 21, at 7 for 7.30 p.m. Any members of the Institute's other branches whose presence in London coincides with the above function will be very welcome to attend. Applications for tickets (price 27s. 6d. each) should be made to Mr. A. R. Parkes, branch assistant secretary, c/o 49, Wellington Street, London, W.C.2. Tables for eight and upwards can be arranged.

Research on Atmospheric Dust in Steel Foundries with Special Reference to the Use of Statistical Surveys*

By G. M. Michie, M.A., A.Inst.P., A.I.M. and G. H. Jowett, B.A., F.S.S.

The comprehensive programme of research being conducted by the steelfounding industry towards the removal of the dust hazard in its various processes is outlined and in this connection the importance both of medical and environmental surveys, and the statistical nature of each are emphasized. Before proceeding to discuss at length the use and interpretation of atmospheric dust surveys, reference is made to dust sampling and estimation and to the potential importance of automatic methods. For purposes of illustration, two environmental dust surveys in steel foundries, the data from which were subject to detailed statistical analysis, are then discussed. The results show the influence on dust level of such factors as the local operational process, the day of the week and the time of the day. In conclusion the statistical considerations involved in the design and analysis of such surveys are discussed.

I—INTRODUCTION

The health hazard associated with the inhalation of atmospheric dust arising during steel foundry processes has, for many years, been the subject of concern within the industry. Investigations carried out with a view to reducing and, so far as is possible, to eliminating the known risks have been directed along three main lines, namely, the prevention of dust generation, the prevention of its inhalation and the reduction in the use of materials containing free silica.

The growing appreciation of the importance of this field of investigation and of the progress already made was marked by the appointment in 1943 by H.M. Chief Inspector of Factories of the Dust in Steel Foundries Committee, which issued its first Report[1] in the following year, and its Second Report[2] seven years later, towards the end of 1951. These Reports are of great value, and have served to draw attention to the difficulty of dealing with what is in fact not a single problem, but a complex of related problems. Some of these are, of course, closely related to problems met in the mining industry, and reference may be made to the extensive researches conducted over many years both by the Safety-in-Mines Research Establishment of the Ministry of Fuel and Power and by the Pneumoconiosis Research Unit of the Medical Research Council. On the other hand, it will readily be appreciated that many of the features of the problem as it is encountered in steel foundries are peculiar to the industry and can only be satisfactorily investigated by co-operative research within the industry itself. Since the disbandment of the Steel Castings Division of the British Iron and Steel Research Association early in 1951, this function has been fulfilled by the Research and Development Division of the British Steel Founders' Association, certain of whose activities in this field are directly sponsored by the Committee on Industrial Health of the B.S.F.A. and its Sub-committee for Practical Work.

It is not within the scope of this Paper to describe in detail the various lines of investigation at present being conducted by the industry through its research organization, its purpose being to describe one particular aspect of the general problem, namely, the use and the interpretation of environmental dust surveys. As a matter of interest, however, the scope of current research in hand by the Research and Development Division of the B.S.F.A. is indicated in Table I.

Superimposed upon the diverse range of problems of the type outlined in Table I, lies the much wider problem of obtaining a measure of the progressive and overall reduction in the dust hazard, such as might reasonably be expected to follow from accumulated knowledge and improved practice. The ultimate answer to this can only, of course, emerge as the outcome of a long-term programme of clinical and X-ray examinations of foundry personnel, carried out over a representative section of the industry. The necessity for a survey of this type was appreciated a number of years ago by the B.S.F.A., who, in January, 1950, initiated a scheme whereby a mobile radiographic unit makes periodic visits to steel foundries in the United Kingdom, when, in conjunction with clinical examinations, full-size chest radiographs are taken of all foundry operatives. Such records as they accumulate, when systematically analysed will, it is hoped, provide evidence of a downward trend in the incidence of steel foundry silicosis.

Medical surveys of this type are by their nature long-term undertakings and perhaps for this reason serve to draw attention to the importance of assessing current environmental dust conditions in the industry. Ideally dust surveys designed with this purpose in view, should be conducted simultaneously and in parallel with the X-ray and clinical surveys, but unfortunately existing methods of dust sampling and estimation are too time-consuming to render such a procedure practicable. From this point of view the importance of developing suitable continuous dust-sampling equipment, together with apparatus for the automatic counting and sizing of dust particles, will be apparent.

Furthermore, it will be evident that, in contrast to the data obtained from a laboratory experiment in which the conditions of test are normally under the control of the investigator, the records

* Paper presented to the Buxton Conference of the Institute of British Foundrymen.

TABLE I.—*Summary of Current Research on Atmospheric Dust in Steel Foundries.*
(Research and Development Division, British Steel Founders' Association.)

Subject.	Object.	Research project.
Suppression of dust	Prevention of "burn-on"	(*a*) Study of mechanism of penetration of mould refractories by molten steel. (*b*) Study of mechanism of moulding sand compaction.
	Limitation in use of pneumatic fettling chisel	Development of "powder washing" and similar techniques.
	Limitation in use of siliceous dust-forming materials	(*a*) Use of non-siliceous mould paints. (*b*) " " moulding materials.
	Suppression by wet methods	Study of efficiency of water and "wet" water for dust suppression purposes.
Dust extraction	Efficiency of local exhaust systems	Aerodynamic studies of local exhaust systems on foundry plant and equipment.
Personal protection from dust	Use of respirators	Development of "air-feed" fettlers' mask.
Properties of dusts	Relative toxicity of various dusts	The isolation of toxic fractions in steelfoundry dusts.
	Physical and chemical properties	Establishment of basic data on the characteristics of different steel foundry dusts.
Dust sampling and estimation	Sampling methods	Development of continuous dust recording meter for use in conjunction with automatic particle counting apparatus.
	Counting and estimation methods	Development of automatic particle counting and sizing apparatus employing "flying-spot" microscope.

emerging from both medical and environmental surveys will have been influenced by a large number of factors, some known, others unknown, which could not be controlled, but which, nevertheless, must be taken into account as far as possible. It is precisely under such circumstances, when the influence of each known variable may be masked by the interaction of others, that statistical treatment of the data becomes virtually imperative.

At the present date it is too early to attempt to apply such treatment to the results of the X-ray and clinical examinations, but statistical analysis has been applied with a considerable measure of success to surveys of environmental dust, and the present Paper includes an outline of some of the methods recently adopted.

II—DUST SAMPLING METHODS

The problem of atmospheric dust sampling has received considerable attention since it was first appreciated that certain chronic diseases of the lung were associated with the inhalation of air-borne dusts. The complete investigation of a dusty atmosphere is a lengthy and difficult task, and in the ordinary course of events examinations are confined to samples obtained with a view to ascertaining (*a*) the number of particles in unit volume of air sampled, and/or (*b*) the weight of dust in unit volume of air sampled.

Samples large enough for chemical and petrological examination may also be required. For surveys or for routine control purposes, the most useful information is however generally obtainable from sampling equipment designed to enable microscopic assessment of the dust concentrations in terms of particles per unit volume of air sampled. The size distribution of these particles is also important since it is now generally accepted that, for an air-borne dust of given chemical constitution, the pneumoconiosis hazard increases roughly in proportion to the concentration of the particles falling within the respirable size range. As a result of numerous tests, as well as from experience gained from *post-mortem* examinations, it is now agreed that typical silicosis is caused by the inhalation of silica particles below 5 microns in diameter. Authorities are not fully agreed as to precisely which particle sizes are the most dangerous, but it would appear that as far as silica is concerned, particles between 0.5 and 1 micron are regarded as the most reactive.

Such considerations have a very obvious bearing upon the type of dust sampling instrument chosen for field survey purposes. After the very extensive investigations made over the past thirty-five years, it is perhaps unfortunate that the various countries have standardized on different apparatus and techniques. The figures obtained with one type of instrument are rarely the same as those obtained with another, and the results are not necessarily convertible by calculation, except under laboratory conditions using a specially-controlled dust cloud. On the other hand, for general dust control purposes in any given industry, the determination of absolute dust concentration values is perhaps of less importance than that the results obtained should be consistent within themselves, and that the sampling technique chosen should be convenient in practice.

Available Instruments

It would not be appropriate in this Paper to describe in any detail the various available sampling instruments, but reference to the more important may not be considered out of place.

(*a*) *Thermal Precipitator*[3].—This instrument, which was originally developed for the Department of Scientific and Industrial Research, was later developed and perfected for use as a standard dust sampling instrument. Its action depends upon the observed effect that when a hot body is placed in a dusty atmosphere it is surrounded by a clearly defined dust-free space, the magnitude of the effect

being dependent upon the temperature difference between the body and the surrounding air. In the Thermal Precipitator a measured quantity of air is slowly drawn over an electrically heated wire, the thermally repelled dust being deposited on two cover glass slips placed on opposite sides of the wire. The efficiency of the Precipitator is 100 per cent. for particle sizes up to at least 20 microns.

The apparatus has been used to a considerable extent for steel foundry atmospheric dust investigations, but the set-up is rather too elaborate and delicate for routine control or survey purposes. The equipment remains however the standard dust sampling instrument, being used as such for reference purposes.

(*b*) *Konimeter*[4].—This instrument, which may take one of several forms, has been used extensively in conjunction with dust investigations in the South African goldmines. In principle the instrument operates by causing the impingement of a measured volume of air sample on to a circular glass plate which is coated with a thin film of glycerine jelly. The dust sample is retained by the glycerine film, where the number of particles are subsequently counted under a microscope.

The instrument is very convenient and simple to operate and takes up to thirty samples on a single plate. The samples are usually counted under "dark ground" illumination and, under favourable conditions, tests have shown that 50 to 60 per cent. of the particles are collected in dust clouds containing from 500 to 2,300 particles per millilitre. Particles smaller than 0.8 micron in diameter are not however usually revealed.

The Konimeter is the standard sampling instrument used in this country for control purposes in the coal mines, but owing to the fact that steel foundry atmospheres may contain a high proportion of particles below 0.8 micron in diameter, the instrument has generally met with less favour than the Owen's Jet.

(*c*) *Owen's Jet*[4].—This instrument, like the Konimeter, operates on the impingement principle, manipulation of a hand pump causing a fifty millilitre sample of air to strike a microscope cover slip which is placed adjacent to a slot-shaped jet. The sample, before entering the jet, passes through a damping chamber, so that the subsequent fall in temperature which takes place as the air expands through the jet is sufficient to cause condensation of moisture on the dust nuclei, causing them to adhere to the cover glass. The water subsequently evaporates leaving a ribbon-shaped dust deposit, which is then assessed by counting under a high-powered microscope.

The efficiency of the instrument is of the order of 40 per cent., being selective for particles smaller than 0.5 microns in diameter. The efficiency for particles above 2 microns in diameter has been shown to be small. Like the Konimeter, the Owen's Jet sampler is particularly convenient because of its simplicity, its light weight and compact form. The necessity however, for changing slides between samples renders its use for rapid sequential sampling rather less practicable.

(*d*) *Greenburgh-Smith Impinger.*[5]—Until recently this instrument was almost universally employed in America, although its popularity in this country was never very great. Both the Konimeter and the Owen's Jet are designed for taking "snap" samples; the thermal precipitator, on the other hand, is designed to sample over a period of 10 to 15 min., and gives a result which is a measure of the average dust level over the period in question at the point sampled. The Impinger is another instrument designed to indicate an average dust level, the sample being taken over a period of time which may be anything up to half-an-hour, according to conditions. A measured volume of air sample is drawn through a water-immersed jet, the dust being retained as a suspension in the water. This is subsequently allowed to settle out in a special counting cell, when it is usual practice to carry out a particle count under a low-power microscope. Under such conditions, however, particles of quartz below 0.8 micron in diameter are not visible. It has been stated that a disadvantage of the Impinger method lies in the disturbance to dust distribution in the air being sampled, arising from the relatively high rate of flow of air into the apparatus.

Continuous Sampling Methods

Reference has already been made to the potential value of continuous dust sampling, and various attempts have been made to develop apparatus suitable for this purpose. Although nothing is yet available which can be regarded as entirely suitable for sampling of steel-foundry atmospheres, mention should be made of a recording dust meter recently developed by the Physics Department of the British Iron and Steel Research Association.[6] In this apparatus the dust-laden air is passed through a tube along which a beam of light is projected. The intensity of the light scattered by the dust particles in a direction at right angles to the illuminating beam is measured by a photo-electric cell, the output of which is amplified and caused to operate the pen of a mechanical chart recorder. The apparatus is designed for continuous operation and its response time of only a few seconds permits detection of rapid changes in atmospheric conditions. Unfortunately, the response of the instrument is not proportional to the number of particles per unit volume of air sampled, the influence of any larger particles present being disproportionately high. While the apparatus may be of value in laboratory investigations involving the use of artificially prepared dust clouds, its application to field surveys would appear to be limited.

Mention might also be made of an automatic dust sampler recently developed by the Safety in Mines Research Establishment of the Ministry of Fuel and Power.[7] The apparatus, which automatically collects filter stain samples of air-borne dust over consecutive intervals of time, has been specially designed for use in coal mines, where dust assessment employing the stain principle has been in use for a number of years. The instrument in its present form is not designed to permit assessment of particle counts, a requirement which at the present time is regarded as

essential in investigations of steel-foundry atmospheres.

III—MEASUREMENT OF DUST LEVEL

It has been stated that the measurement of environmental dust levels presents a problem which is as difficult to resolve as the estimation of lung damage itself. Having overcome the sampling difficulties, one is faced with the problem of carrying out the laborious particle counts associated with the estimation of the samples. Furthermore, counts obtained on a series of "snap" samples obtained at intervals in any chosen area in a foundry are frequently found to show large variations from moment to moment and from day to day, and in consequence difficulty arises in expressing the dust level in this particular area. The problem is, of course, a statistical one, and in order to establish a significant difference in dust level between two different areas, it may be necessary to obtain a large number of samples. Considerations of this sort serve to emphasize the importance, not only of simple and rapid sampling methods, but of techniques designed to permit rapid assessment of the dust samples themselves.

(*a*) *Direct Counting* (Owen's Jet samples).—Owing to the small size of the dust particles sampled by the Owen's Jet instrument, counting must be carried out at a high magnification, usually × 1,000, using a 2-mm. oil-immersion objective. While counts are normally obtained using "light ground" illumination, "dark ground" illumination using a 4-mm. objective may also be used. Whichever technique is adopted should, of course, be adhered to, at least throughout the assessment of samples from any given survey.

The eyepiece of the microscope is usually fitted with a special graticule, which is used to obtain a direct count of all the particles contained in three narrow strips chosen in representative positions across the ribbon-shaped dust record. By determining the number of such strips required to cover the whole sample, a simple calculation gives the total number of particles deposited from the 50 ml. of air sampled. The count is then expressed in particles per ml.

The counting of a single Owen's Jet sample using this technique normally requires 10 to 20 min., depending upon the density of the sample and upon the skill and experience of the observer. Furthermore, the number of samples which can be handled in any one day by one observer are limited by such considerations as eye fatigue.

(*b*) *Use of Photomicrographic Dust Scale.*—The use of a comparator scale for purposes of estimating counts is not new, the principle having been employed for a number of years for the estimation of inclusion counts in steel. In 1948, a paper[8] presented to the Society of Chemical Industry by W. B. Lawrie described a similar scale which had been evolved for the rapid estimation of dust in iron and steel foundries. The technique has since been employed with a considerable measure of success in at least two major dust surveys in steel foundries, one of which is later described in the present paper.

The scale consists of a set of six photomicrographs taken at a magnification of × 1,000, showing a series of samples having progressively increasing dust concentrations. Each step in the scale represents an increase of 100 per cent. in concentration over the previous step, the scale covering a concentration range from 200 to 6,400 particles per m.l. For reference purposes the steps have been numbered 1-6 as indicated in Table II.

It will be noted that six half grades have also been introduced to permit the better classification of specimens showing concentration between any two main grades. The scale itself does not include photomicrographs of the half grades, since concentration steps of 100 per cent. were considered adequate for estimation purposes.

Samples to be estimated against the Lawrie scale need not necessarily be photographed, since in practice it is more convenient to compare the projected image directly with the photomicrographic scale. Ideally of course the samples should be examined under optical conditions similar to those employed in the preparation of the scale.

The use of the comparator method of estimating dust samples has been invaluable in recent survey work, since it permits estimations to be carried out at a rate of between thirty and fifty samples per hour.

(*c*) *Automatic Particle Counting.*—The problem of particle size counting arises in many diverse fields, and the possibility of devising suitable apparatus to replace the human observer has in the interests of speed and accuracy already received widespread attention.[9] A development of particular interest in relation to the estimation of atmospheric dust samples was recently announced by Professor J. Z. Young and Mr. R. Roberts,[10] of University College, London. This consists of a "flying-spot" microscope in which the specimen is rapidly scanned by a minute spot of light, the transmitted intensity of which is recorded by a sensitive photo-multiplier tube. Pulse analysing equipment for use in conjunction with this instrument is at present under development by Prof. Young on behalf of the Research and Development Division of the B.S.F.A.

TABLE II.—*Lawrie Photomicrographic Scale for the Estimation of Dust Samples.*

Group No.		1		2		3		4		5		6
Particles per ml.		200		400		800		1,600		3,200		6,400
Group No.	½		1½		2½		3½		4½		5½	
Particles per ml.	100		300		600		1,200		2,400		4,800	

IV—SUMMARIZED RESULTS OF TWO ENVIRONMENTAL DUST SURVEYS

The two surveys to be described were initiated by the Sub-committee for practical Work of the Committee on Industrial Health of the British Steel Founders' Association. Neither of the two surveys was originally designed for detailed statistical treatment and consequently the subsequent analysis proved more complicated than might otherwise have been the case. Both surveys were essentially exploratory in character, being conducted at a time when the reliability of methods, both for the measurement and the assessment of the dust content of steel foundry atmospheres, was a matter of some uncertainty.

For the reasons suggested earlier, the sampling instrument chosen for use in these surveys was the Owen's Jet. It will be appreciated that the results of the surveys are therefore entirely dependent upon the sampling efficiency of this particular method of dust sampling, and in consequence any conclusions which may be drawn from the results must take this into consideration.

A—First Survey

(*a*) *Purpose of Survey.*—This survey had as its objective the determination of the bearing, if any, of the following factors upon the level of atmospheric dust in each of six selected steel foundries:—(i) The operational process (as it might affect local dust level); (ii) the day of the week; and (iii) the time of day.

The six steel foundries which participated in this survey volunteered to co-operate and were not therefore selected in any particular fashion. It was nevertheless considered that for the purpose of the survey the foundries in question could, to all intents and purposes be regarded as sufficiently representative of the industry as a whole.

(*b*) *Design of Survey.*—The survey was of fourteen working weeks' duration (October 16, 1950, to January 20, 1951), being conducted simultaneously in each of the six participating foundries. Samples obtained using the Owen's Jet instrument were taken once daily at each of six agreed sampling points in each of the six foundries, the sampling schedule being shown in Table III. It will be clear from this Table that the same sampling cycle is repeated at four-weekly intervals. For the purpose of the survey, sampling points in each foundry were chosen in the following areas:—Sand mill, knock-out, moulding area, shot blast, fettling.

In order to permit, if subsequently considered necessary, the correction of the foundry readings for the influence of external atmospheric pollution, a "control point" located outside each foundry was also included in the sampling schedule. Analysis of control point data is not however considered in the present Paper. The points were sampled in rotation, the interval between successive samples being determined by the time taken to move from one sampling area to the next and to change the sample slip in the Owen's Jet instrument. The samples, each of which was taken in triplicate, were subsequently assessed against the Lawrie photomicrographic scale.

(*c*) *Results of Survey.* (i) *Mean Dust Level in different areas in each foundry.*—A comparison of the mean dust levels adjacent to the five processes investigated is shown in Table IV and is further graphically demonstrated in Fig. 1. This indicates that on the average there is a progressive increase in dust level from the sand mill to the fettling area. This pattern of dust variation from area to area is not strictly conformed to by all foundries, the extent of the divergence in the case of foundry I, for instance, being graphically illustrated in Fig. 2. In this figure the broken lines indicate the limits outside which an area mean must lie in order to give conclusive evidence of a divergence from the average pattern. Thus while foundry VI may be considered to conform to the average pattern, foundry I does not, in that its moulding and fettling areas show respectively higher and lower dust levels than would have been the case had the variations, as compared with other areas, been in conformity with the average pattern. It should however be noted that this does not necessarily imply that these areas exhibit dust levels which in themselves are either high or low

TABLE III.—*Sampling Schedule (First Survey).*

Sampling time.	Day of the week.			
	Weeks 1, 5, 9 and 13.	Weeks 2, 6, 10 and 14.	Weeks 3, 7 and 11.	Weeks 4, 8 and 12.
9.30 to 10.00 a.m.	Monday	—	—	—
11.30 to 12 noon	Tuesday	Monday	—	—
1.30 to 2.00 p.m.	Wednesday	Tuesday	Monday	—
3.30 to 4.00 p.m.	Thursday	Wednesday	Tuesday	Monday
9.30 to 10.00 a.m.	Friday	Thursday	Wednesday	Tuesday
11.30 to 12 noon	—	Friday	Thursday	Wednesday
1.30 to 2.00 p.m.	—	—	Friday	Thursday
3.30 to 4.00 p.m.	—	—	—	Friday

TABLE IV.—*Mean Dust Level in Different Areas.*

Foundry area.	Mean group number.						
	All foundries.	Individual foundries.					
		I.	II.	III.	IV.	V.	VI.
Sand mill ..	4.06	4.36	3.83	4.15	3.59	3.99	4.42
Moulding ..	4.24	4.99	3.88	4.77	3.50	3.84	4.47
Knock-out ..	4.34	4.99	4.07	4.60	3.49	4.41	4.49
Shot-blast ..	4.42	4.69	3.68	5.08	3.78	4.41	4.90
Fettling	4.66	4.60	3.89	5.21	4.98	4.26	5.04
Mean (all areas) ..	4.35	4.72	3.87	4.73	3.87	4.18	4.66

NOTE.—The area means for the separate foundries have a possible statistical error of up to about 0.27 units.

TABLE V.—*Mean Dust Level on Different Days of the Week*

Day of week.	Mean group number.						
	All foundries.	Individual foundries.					
		I.	II.	III.	IV.	V.	VI.
Monday	4.40	4.88	4.00	4.70	3.78	4.31	4.67
Tuesday	4.52	4.68	4.16	4.94	4.10	4.27	4.91
Wednesday ..	4.23	4.59	3.74	4.52	3.68	4.34	4.44
Thursday ..	4.14	4.50	3.98	4.40	3.75	3.71	4.44
Friday	4.44	4.93	3.47	5.08	4.01	4.25	4.85
Mean (all days) ..	4.35	4.72	3.87	4.73	3.87	4.18	4.66

NOTE.—The day means for the separate foundries have a possible statistical error of up to about 0·27 units.

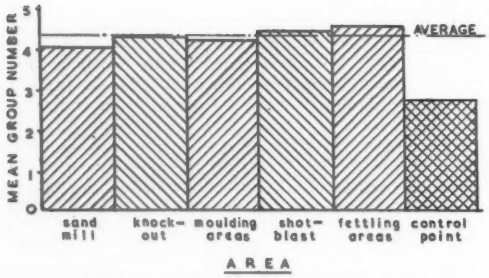

FIG. 1.—*Mean Dust Level in Different Areas (all foundries).*

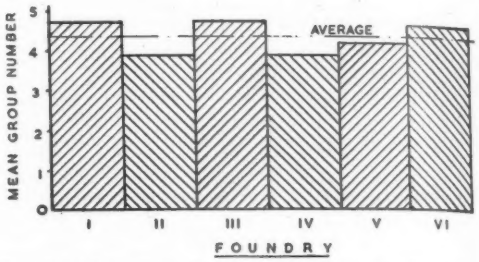

FIG. 3.—*Mean Dust Level in Different Foundries (all areas).*

with respect to other foundries. Comparisons of this nature are better made by reference to Table IV.

Examination of the area "means" obtained for all foundries from week to week showed no significant divergence from this average pattern. A comparison of individual foundry "means" is shown graphically in Fig. 3, which indicates that, taking all areas into consideration, foundries I, III, and VI are more dusty than the remainder. A more detailed comparison of the figures is not, however, advised, since further differences that may be apparent cannot be regarded as statistically significant.

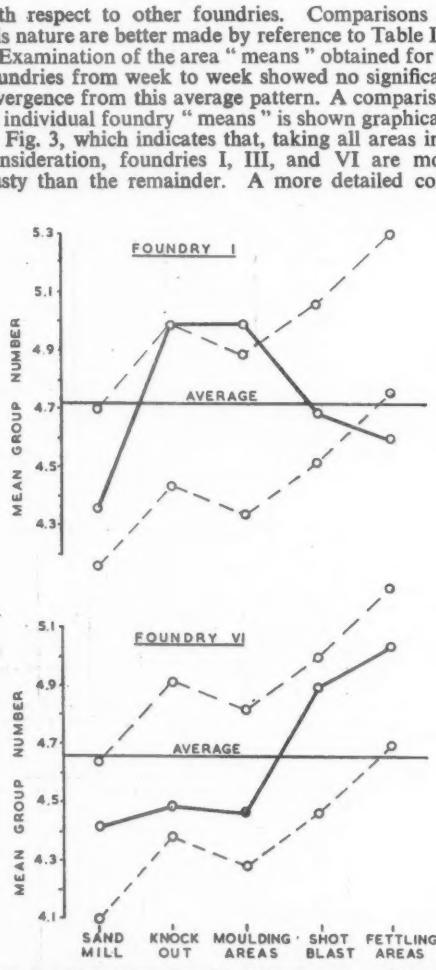

FIG. 2.—*Mean Dust Level in Different Areas (foundries I and VI). Broken lines indicate limits outside which a point must lie to give conclusive evidence of a divergence from the average pattern.*

(ii) *Mean Dust Level on different days of the week in each foundry.*—A comparison of day means is shown in Table V and graphically in Fig. 4. Wednesday and Thursday tend to be less dusty than Monday, Tuesday and Friday. This pattern is fairly consistent from foundry to foundry, at least to within limits dependent upon the statistical accuracy of the means. On Friday, however, the dust level in foundry II is conspicuously low (see Fig. 5), whereas on Thursday the situation is reversed. Foundry VI on the other hand shows conformity with the average pattern.

(iii) *Mean Dust Level at different times of the day in each foundry.*—A comparison of the time-of-day means is shown in Table VI, and graphically in Fig. 6. The dust level tends to be highest between 9.30 and 10 a.m. and lowest between 1.30 and 2 p.m. There are divergences from the average pattern as illustrated by foundry IV (see Fig. 7), in which the dust level at the beginning of the day is markedly low, a feature which is probably worthy of further investigation. Fig. 7 also shows that in foundry III there is a decrease in dust level from the beginning of the day to the end.

(*d*) *Criticism of Survey.*—The general conception and lay-out of this survey was on the whole statistically satisfactory, the parallelism existing between observations for each area in each foundry considerably simplifying comparisons between areas and foundries. Once estimates of foundry/area/week means had been obtained, comparisons between foundries and areas, as given in Table IV, became possible by simple averaging. If in some

TABLE VI.—*Mean Dust Level at Different Times of the Day.*

Time of day.	Mean group number.						
	All foundries.	Individual foundries.					
		I.	II.	III.	IV.	V.	VI.
9.30–10.00 a.m. ..	4.56	4.84	4.26	5.26	3.66	4.15	5.11
11.30–12.00 noon	4.31	4.68	3.64	4.73	3.94	4.32	4.46
1.30–2.00 p.m. ..	4.18	4.57	3.83	4.48	3.78	3.95	4.32
3.30–4.00 p.m. ..	4.33	4.76	3.64	4.42	4.07	4.28	4.73
Mean (all times)..	4.35	4.72	3.87	4.73	3.87	4.18	4.66

NOTE.—The time-of-day means for the separate foundries have a possible statistical error of up to about 0.24 units.

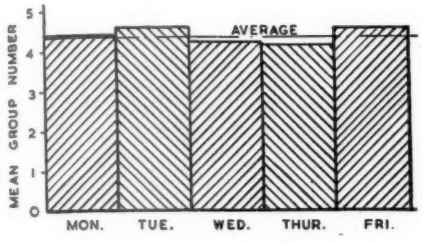

FIG. 4.—*Mean Dust Level on Different Days of the Week (all foundries).*

foundries more areas had been represented than in others, or if some areas had been neglected in particular weeks, the comparisons would not have been so easy, and a good deal of statistical adjustment necessary. For example, if during certain weeks the fettling area samples had been omitted in one foundry, the mean for that foundry would have been biased on the low side, in view of the fact that the fettling areas tend to be more dusty. A correction for this bias would then have been necessary.

In order to avoid the risk of confusing possible day effects with possible time effects, the time of day at which each set of samples was taken was varied from day to day in accordance with the pattern which has been shown in Table III; it was thus possible to calculate means of, say, Monday observations, in which means for all four times of day were represented. While this in itself was a statistically sound procedure, it was responsible for increasing the complexity and labour of the analysis necessary for estimating foundry/area/week means. Thus the variation of sampling schedule from one week to the next made it difficult to compare weekly means.

In two weeks chosen for comparison, one might have, say, two 9.30 a.m. readings, the other two 1.30 p.m. readings. In consequence the mean dust level for the first week has an upwards bias relative to the second, because of the tendency for 9.30 a.m. to be the dustier time of the day. Thus, while some comparisons, such as those between foundries and areas, could be carried out by simple averaging, others could only be made after suitable adjustment for differences in constitution of the groups of observations involved. Unfortunately, too, the pattern was not always strictly followed; sometimes samples were missed and occasionally sampling times were interchanged. Moreover, there were two opinions as to how to recommence the sampling schedule after a holiday period. From the statistical point of view, it is important not to spoil the pattern of an experiment; for the occasional inevitable missing reading it is possible to provide a "dummy" which is without bias, but this cannot be done too often.

In calculating the means given in Tables IV to VI, adjustments of this sort have therefore had to be made. While these statistical manipulations do not in any way invalidate the comparisons, they were troublesome and time-consuming to carry out and not easily understood by those unfamiliar with statistical methods.

For these reasons it would have been better to have chosen five times of day instead of four times, and to have varied these randomly from week to week. If this were too difficult to organize in practice, a cycle of five times of day could have been started at a different time at the beginning of each week; on statistical grounds this procedure is less desirable. Either of these procedures would have enabled many more comparisons to have been made by means of straightforward averaging.

B.—Second Survey

(*a*) *Purpose of Survey.*—In the first survey, the sampling was restricted to four short periods of the day, and consequently the results were not capable of yielding information on the minute-to-minute or hour-to-hour variation in dust level in any of the

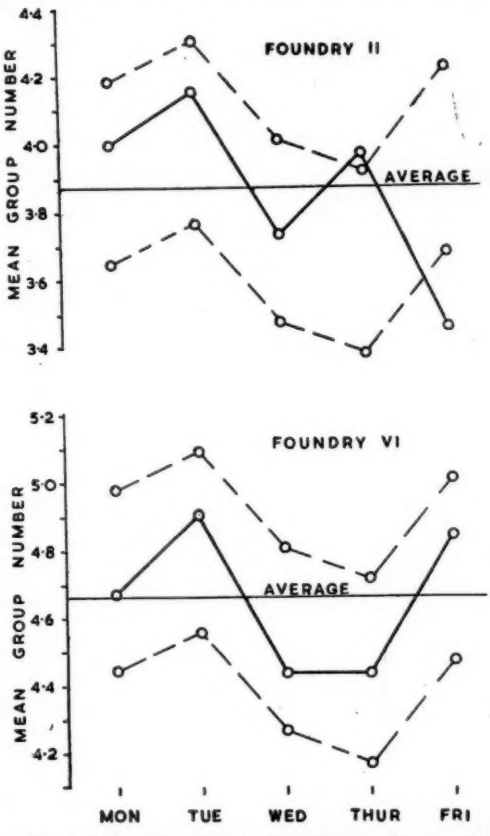

FIG. 5.—*Mean Dust Level on Different Days of the Week (foundries II and VI). Broken lines indicate limits outside which a point must lie to give conclusive evidence of a divergence from the average pattern.*

FIG. 6.—*Mean Dust Level at Different Times of the Day (all foundries).*

areas under investigation. Yet not only is such information important to an understanding of the behaviour of foundry atmospheric dust, but it may also be of potential value in relation to future survey design, since a knowledge of the hourly variation may serve to guide in the selection of representative sampling times.

A second exploratory survey was therefore undertaken with the limited but specific purpose of investigating the quarter-hourly variations in the dust level in the fettling shops of two of the foundries included in the first survey.

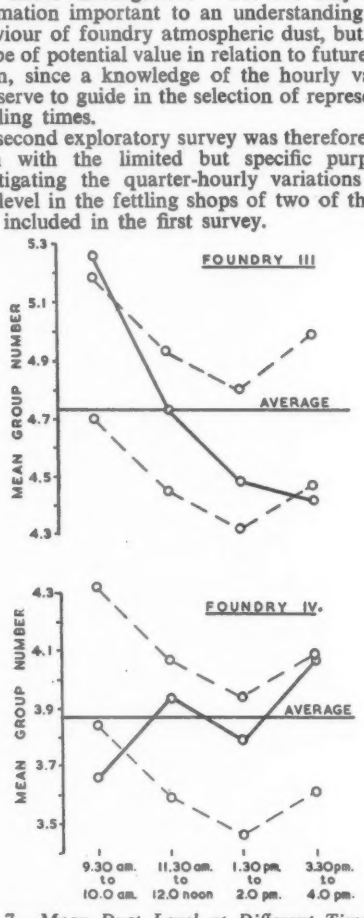

FIG. 7.—*Mean Dust Level at Different Times of the Day (foundries III and IV). Broken lines indicate limits outside which a point must lie to give conclusive evidence of a divergence from the average pattern.*

(*b*) *Design of Survey.*—This second survey, which was conducted in the fettling shops of foundries II and III using the same sampling points as in the previous survey, covered two separate periods of five working days in each foundry. Dust samples collected by Owen's Jet were taken at fifteen minute intervals throughout each day, from 7.30 a.m. to 5.45 p.m. In view of the smaller number of samples involved in this second survey, they were assessed by means of direct particle counts instead of being estimated against the Lawrie scale. The results expressed in terms of numbers of particles per m.l., were analysed as they stood.

(*c*) *Results of Survey.*—The average day pattern observed in each foundry during the period of the survey is illustrated graphically in Fig. 8. In the calculation of the means, allowance had to be made for the special conditions apparently existing after 3 p.m. on Friday afternoon. The pattern does not apply to this period.

The drop in dust level at meal-breaks is noticeable, particularly in foundry III. Little or no lag is apparent between the commencement of the meal break and the drop in dust level. It might be inferred from this that as soon as work ceases, either (i) immediate settlement of a portion of the dust occurs, or (ii) the lull in activity permits ventilation and/or convection currents to remove the dust-laden air. In view, however, of the small size of the particles sampled by the Owen's Jet instrument, the latter alternative would appear more likely.

(*d*) *Criticism of Survey.*—The survey achieved its

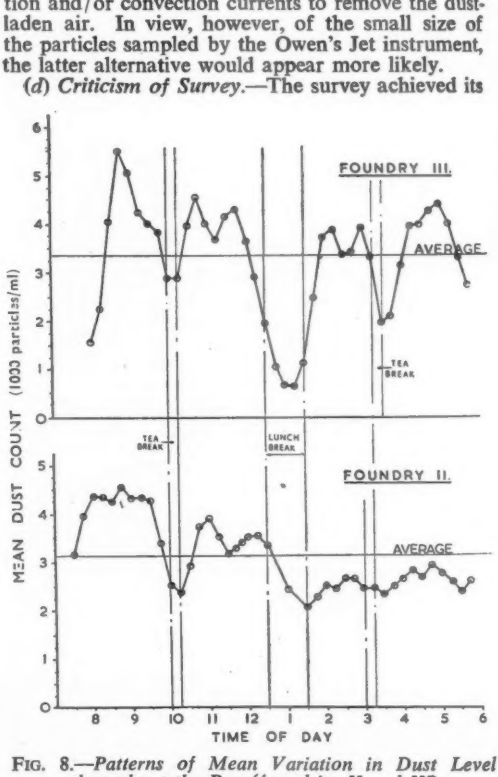

FIG. 8.—*Patterns of Mean Variation in Dust Level throughout the Day (foundries II and III).*

limited aim of obtaining information about variations in dust level over fairly close intervals. The results could not of course be used to establish the form of day-to-day differences since each weekday was represented only once in each foundry. For the same reason it was not possible to determine to what extent variations from the mean day pattern on any particular day were transient or to what extent they were characteristic of that particular day of the week.

For the reasons explained in Section V(*d*), it would probably have been better to have analysed the data using group numbers rather than particle counts, when the results would probably have shown more stability.

(To be continued)

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[9] "Automatic Counting of Microscopic Particles," *Nature*, 1952, **169** (4300). March 29, 518-520.
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Barrow Hematite Distribution

Announcing the distribution of 26s. 6d. per £1 stock unit, the directors of the Barrow Hematite Steel Company, Limited, state that they are of the opinion that it would not be in the best interests of stockholders, if given the opportunity, to reacquire the assets taken over by the Iron and Steel Corporation of Great Britain. In 1948 the company's ironworks were transferred to Barrow Ironworks and in February, 1951, the whole interest was transferred to the Iron and Steel Corporation, together with the substantial interest in the Ullcoats Mining Company.

Under the circumstances, the distribution of £937,106 is recommended by way of repayment of 10s. per £1 unit, absorbing £353,625 11s. 6d., free of tax, as a special dividend payable out of revenue reserves, absorbing £406,669, and the remaining £176,812 out of revenue reserves by way of 7 per cent. cumulative redeemable preference £1 shares in the company.

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ing Course" is one of its major contributions to the industry, and he has himself tried to find time to give lectures, not only to foundry foremen, but to foremen in other industries in which he is interested. Foremen are part of management, they form the managerial contact with the men and are the interpreters of the day-to-day policy of the firm's administration. It will be remembered that the president, in his address last June to the Institute, expressed views on the training of craftsmen and the possibility of upgrading newcomers to crafts during their lifetime. This indicates that the personnel in the industry can fruitfully be drawn from a wider field.

Views on the Steelfoundry Industry

By Dr. C. J. Dadswell

Dr. Cyril Dadswell, whose portrait and life-story are featured in this month's "Leaders of the Industry" (pages 524 and 525), has kindly expressed his personal views of the steelfoundry industry in this country and its inter-relation with the work of the Institute of British Foundrymen, of which he is president:—

He considers that the steelfoundry industry has made remarkable strides in management, technique and production in the last fifteen years and, nowadays, some of the steelfoundries in this country compare favourably with any in the world. A likely tendency will and should be for steelfounders to specialize in certain ranges of products, a tendency which is already becoming very marked, leading to improvement in technique and economies in production.

The president well remembers the days when the manager of a steel foundry was seldom invited to visit another and holds that a remarkable change in this respect has taken place over 20 yrs., and that membership of the Institute itself has been one of the contributory factors in the breaking down of the barriers. When first he was making a grand tour of foundries in Great Britain before visiting France for a year's study, introductions to the management of those steel foundries were made through the Institute. Secondly, having become a manager, personal contacts with other managers through membership of the Institute led to the opening of doors. This broader-minded attitude which has developed so rapidly with the present living generation of foundrymen, of course, comes from many influences, including trade associations, economics, wartime necessity, and so forth, but was evident before the war and is largely due to the personal contact between fellow members of the Institute, and that camaraderie and enthusiasm which somehow exists between all interested in foundry work.

Research and Training

Developed out of the collaboration amongst steelfounders under their particular Association, the most marked advance of recent years is the collaborative research which a large proportion of the founders have now joined under the B.S.F.A. Research & Development Division, of which Dr. Dadswell is vice-chairman. One is apt to think, he says, that if one has a works research department and good technicians, co-operative research is an unnecessary expenditure. Personal experience has shown that, first, exchange of ideas and comparative experimental work is valuable, and second, that more often than not both management and technicians are so busy with day-to-day problems that long-term fundamental and practical research does not get carried out, and in any case is only possible in the larger organizations. In the smaller foundries, facilities do not exist for this work and the only remedy is through co-operative research. In their case, there is a tendency to look at the cost of co-operative research in relation to "so much per ton of castings produced," but they have already realized that it is money well invested.

For a long time, the president has been interested in the training of supervisors and foremen, considering that they form the bulk of management in the works and, therefore, should have training for their job. This is why, he thinks, the Institute's "Foremen's Train-

(Continued at the foot of Col. 1)

Improved Working Conditions

At the recently-held banquet at the Guildhall, organized in connection with the Annual Convention of the Joint Iron Council, the Rt. Hon. Sir Walter Monckton, Q.C., Minister of Labour and National Service, was principal guest. An extract from his address, which commends founders for their efforts in providing improved working conditions, is printed below:—

"Dealing specially with the ironfounding section of the industry, with which I have had some opportunities in the last few months of coming directly into contact, I think I can say, without being accused of postprandial flattery, that the ironfounding industry as a whole has given many signs in the last few years of its desire and resolute purpose to be progressive in all its ways.

"Take, for example, the improvement of working conditions. There are in the United Kingdom something over 2,000 iron foundries, including the foundry departments of firms which make castings for their own use. They are of all sizes, ages and degrees of modernization. For many of their operatives, even in the most highly mechanized plants, the work is arduous and occasionally dirty, often involving exposure to extremes of heat and cold and sometimes to other conditions which may, if not counteracted, be harmful to health. I am glad to put it on record that year after year, and increasingly since the war, the Factory Inspectors of my Department have been able to report a most gratifying advance towards the improvement of conditions in iron foundries, notably in the provision of up-to-date welfare and health services and amenities, including, for instance, facilities for washing and changing of working clothes. The research work being carried out by the Foundry Atmospheres Committee of the British Cast Iron Research Association on the prevention of the inhalation of dust and fume in foundries, provides an example of the contribution which is being made by the industry to the establishment of a healthier environment for foundry workers.

Training and Productivity

"Great progress has been made, too, in the provision of systematic training for employees—not only junior executives, technicians and foremen, but apprentices and others who are needed to replenish the supply of skilled craftsmen and make up a balanced working force. At the same time, there has been a notable development of organized scientific and technical research into methods of improving production both in quantity and quality.

"Best of all, I believe the industry generally has been taking very seriously to heart the lessons brought back from the United States by the team of directors managers, technicians and operatives which visited that country two years ago under the ægis of the Anglo-American Council on Productivity."

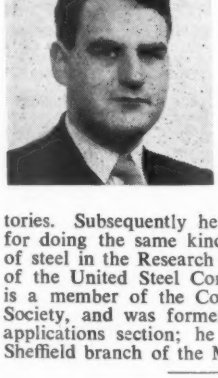
Consett Iron Company, Limited, is to convert an old infirmary in Consett (Co. Durham) into a training centre.

F.T.E. & S.A. Elections. During the business section of the annual general meeting of the Foundry Trades Equipment and Supplies Association, held at the Waldorf Hotel, London, recently, Mr. Frank Webster, (August's, Limited) was elected president with Mr. W. Rawlinson (J. W. Jackman & Company Limited) and Mr. C. Orton Foster (British Foundry Units Limited) as vice-presidents.

Conference Paper Authors

MR. G. M. MICHIE, M.A., A.Inst.P., A.I.M., is co-Author with Mr. G. H. Jowett, B.A., F.S.S., of the paper "Research on Atmospheric Dust in Steel Foundries, with special reference to the Use of Statistical Surveys," printed on page 527 of this issue. A short biography of Mr. Michie was printed on page 614, November 29, 1951.

MR. G. H. JOWETT, who is joint Author with Mr. Michie, is lecturer in Statistics at the University of Sheffield, which he joined in 1948. He was educated at Hemsworth Grammar School and King's College, London. In 1942 he entered the Ministry of Supply's Advisory Service on quality control (S.R.17), and applied statistical methods to production and inspection at a number of ordnance factories. Subsequently he helped to establish a section for doing the same kind of work in the manufacture of steel in the Research and Development Department of the United Steel Companies, Limited. Mr. Jowett is a member of the Council of the Royal Statistical Society, and was formerly chairman of its industrial applications section; he is also vice-president of the Sheffield branch of the Mathematical Association.



Dr. D. V. Atterton is the Author of the Paper "Thermal Expansion and Contraction of Compacted Steelfounding Sands and Mould Washes"* presented to the Buxton Conference of the Institute of British Foundrymen. He was educated at King's School, Rochester, and at Bishop Wordsworth School, Salisbury. He entered Peterhouse, Cambridge University, in 1944, where he read Parts I and II of the Natural Sciences Tripos. In 1947 he was awarded the B.A. degree (1st class honours in metallurgy) and was elected a College Bachelor Scholar. In the same year he commenced research under Dr. T. P. Hoar, and in 1950 he was awarded the Ph.D. degree for a thesis describing his work on the penetration of molten metal into compacted sand and on the surface tension and contact angle with silica of molten tin. He was then engaged for two years in further fundamental research on foundry problems, receiving financial support from the British Steel Founders' Association. He joined Foundry Services Limited in July of this year to fill the post of research and development manager.

* Paper printed in the JOURNAL, July 17; the discussion is printed on page 537 of this issue.

Thermal Expansion and Contraction of Compacted Steelfounding Sands and Mould Washes*

Discussion of Dr. D. V. Atterton's Paper

MR. J. L. FRANCIS said, in carrying out investigations with wood-flour, Dr. Atterton had obtained results which in some respects did not conform with what was known to take place in actual foundry practice. For this there must be some very good explanation and it would be interesting to hear more about it. Referring to page 6 of the pre-print, which dealt with wood-flour, some short time previously he had read a report (No. 280) by Taylor, which indicated that 1 per cent. of fibrous material completely eliminated scabbing, and further work done by the British Cast Iron Research Association (report No. 326) confirmed and elaborated that statement. Evidence was provided to show that the maximum stress set up by expansion was reduced, but, at the same time, the corresponding strain was greatly increased. When the strain was high and the stress fell slowly, the sand was more plastic and less likely to cause scabbing. Also, what sort of wood-flour had Dr. Atterton used, as qualities of this material vary a great deal?

On the same page there was some reference to the burning-out of the oil-bond in a mould wash, giving more void space, which partially counteracted expansion and, if that were the case, why should the mechanism not be the same with moulding sand when wood-flour or cereal was added? It was a well-known fact that oil-sand mixtures were not prone to scabbing. In fact, in some cases, oil-sand was used in order to stop scabbing.

Practical Foundrymen's Viewpoint

With regard to the subject of uniformly-graded sands, he remembered seeing some very impressive slides produced by Mr. W. B. Parkes, showing that the worst scabs were found with a uniformly-graded sand. As far as the use of materials like zircon was concerned, there was much natural moulding sand available which he expected would still have to be used, so efforts should be made towards finding out how it could be improved. It might be that the Author was under some misapprehension as regards facing sand and underlying sand, and the difference in expansion causing scabbing. He was not sure that Dr. Atterton had the same thing in mind when referring to facing sand and backing sand that he, as a foundryman, had. Facing sand was a layer of sand up to an inch in thickness and, having in mind the relatively poor heat-conductivity of silica sand, he did not think the expansion of backing sand would take place within a period of time such as would affect the face of the casting. On the other hand, if the Author had in mind a very thin layer of facing sand the result might be very different.

DR. ATTERTON said, with regard to wood-flour (and similarly in the case of cast iron, where pitch was very often added in the same way), he had not carried out a statistical survey but had questioned a few people and they were divided about fifty-fifty, as to whether wood-flour made any improvement. The apparent anomaly between the influence of Glyso and of wood-flour in mould-wash and sand, respectively, might possibly be explained by the considerably greater ratio of binder material to total solids in the wash, as was suggested in the Paper.

When he referred to uniformly-graded sand, he meant a good distribution of grains, and with regard to zircon and olivine sand, although he appreciated the problems involved, he maintained that if one had a casting which was susceptible to scabbing, their use was a way to avoid it.

Facing and Backing Sand

He did not think he had used the term "backing sand"; he had referred to the mould face and the underlying layers of facing sand, by which he meant a layer of the order of 2 cm. thick. The backing sand probably would not reach any significant temperature during the filling of the mould, but a facing layer about 2 cm. thick might quite well, in a large casting, reach appreciable temperatures. He did not think anyone really knew what temperatures the mould surface actually reached before contact with molten metal, or how rapidly it heated up.

MR. A. TIPPER remarked that the point had been dealt with both by British and American sources and there were records which gave precisely that information. Several papers had been presented during the previous year to the American Foundrymen's Congress, bearing on the subject and quoting temperature measurements, and work had been going on during the past two years at Birmingham University on the influence of moulding materials on the rate of freezing. Quite a lot of this information was available to the Institute, although it had not yet been published. The whole idea was to try to compare the chilling properties of moulding materials and their influence on defects in castings. With iron cast at 1,350 deg to 1,400 deg. C., sand temperatures of about 800 down to 300 deg. C. were obtained. As one moved back from the metal face, the fall was extremely rapid, but at a distance of perhaps $\frac{1}{8}$ in. from the face temperatures of 800 or 900 deg. C. were obtained in a matter of two or three seconds, still within the time that the metal was solidifying, and therefore the temperature differential undoubtedly had a bearing on the actual formation of a scab.

DR. ATTERTON said that he realized this but he

* Paper printed in the JOURNAL July 17.

referred here to the temperatures reached by sand before coming into contact with the molten metal. The important thing, from the point of view of the formation of a scab, was surely the temperature attained by the sand prior to contact with the molten metal?

Expansion Characteristics

MR. SNELSON, referring to Fig. 6 of the Paper, where the effect of moisture content was investigated, said that the densities of compacts given for sands A and B were quoted but he would like to know whether they were the dry-densities of those compacts, and if so, were the compacts tested for expansion in Fig. 6 of the same dry bulk-density.

DR. ATTERTON replied that they were the dry-densities of the compacts. Naturally, the compact was prepared in the "green" state and the moisture content of the sand was then measured; it was then dried and the density determined.

MR. SNELSON observed that there was an increase of expansion with the 10 per cent. bentonite sand at a certain moisture content, and queried whether it corresponded at all with the moisture content and green-permeability relationship. It was well known that permeability reached a maximum at a given moisture content of a sand.

DR. ATTERTON, judging by the order of magnitude, said the expansion did possibly conform to that.

MR. SNELSON said there was no doubt that something was happening to the clay films on the sand grains at a critical moisture content, and the effects shown in Fig. 6 might be associated with this phenomenon.

DR. ATTERTON said his own opinion on the actual physical significance was that, at about this moisture content, no more water layers were formed around the silica grains and any additional moisture accumulated in the pores between the grains.

MR. SNELSON remarked that it was particularly significant when one considered the effect of the relation between green and dry permeability. Norton, in 1932, demonstrated very nicely the effect of water in clay specimens and, if that explanation could be extended to clay-water films on sand grains, then one could really get down to an explanation of the effect of water on the permeability of dry sand, and so on.

"Green" and "Dry" Sands

MR. DAYBELL said the discussion had been about moulds which had been cast in the dry state, and he would like to know whether the same applied when a mould was cast in the "green" state. Also he would like to have the Author's opinion of the penetration of metal into sand when apparently it had not penetrated the mould-wash.

DR. ATTERTON said the relevant property was the hot-strength of the sand, which was a very difficult thing to measure. When casting in a green-sand mould, it was possible to get a form of scabbing arising from entirely different causes—probably from the expansion of the moisture in the sand—but, if the green sand when dried had a high strength, the scabbing should be less. With a fairly heavily washed surface, it was possible to take a chisel and prise the whole penetrated layer away from the mould face. This was due to the formation of cracks in the mould-wash through which molten metal flowed and "mushroomed-out" into the relatively coarse underlying facing sand. When the chisel was inserted, the metal "probes" which linked the penetrated sand to the casting were broken. The existence of such probes, however, had been demonstrated metallographically.

Special Test-pieces

MR. RIDSDALE said it was interesting to note that the Author had dismissed the use of the standard test-piece at an early stage, and a perusal of the Paper made it clear that for research work of that nature the quite large test-piece was unsuitable. Was it considered that the test reported was one which foundrymen might want to apply in their own foundries, and if so, whether the errors that occurred on the standard test-piece, either 2 by 2 in. or 2 by 1½ in., would be considered great enough to rule them out for control tests. He presumed that the actual compression-strength tests quoted in one of the Tables were carried out on standard test-pieces.

DR. ATTERTON replied that they were. As to carrying out expansion tests in the foundry, the whole job would be very cumbersome, whichever way it was done, and he did not think it was the sort of thing one could visualize being carried out there. Nevertheless, a thermal-shock test could give quite valuable information and one could see the appearance of the cracks, which was certainly an indication as to whether a sand would scab or not. The tests described in the Paper were carried out for the express purpose of obtaining an accurate measure of expansion, which could not be obtained with a large test-piece.

MR. RIDSDALE interjected that the Author had referred to the work of Dietert, who presumably did his work on his Expansiometer.

DR. ATTERTON, in reply, said that, from the point of view of use in the foundry, any determination of expansion was bound to need quite an elaborate apparatus, and he considered that used by Dietert was just as elaborate as he had used. He felt that the actual figures quoted by Dietert for expansion were probably incorrect, for the reasons suggested in the Paper.

MR. WILSON enquired whether the Author had found any difference between the bentonites from Wyoming and those from South Africa.

DR. ATTERTON replied that he had not investigated this at all, but possibly any variations in strength, due to the variations in quality, would be reflected not in the magnitude of expansion but more in the ability of the sand to withstand thermal stresses. The use of North-African bentonite, which he thought it was generally agreed did not give such high strength values as the Wyoming,

might possibly increase the tendency towards scabbing.

MR. DEWEZ said he had been in the United States for the last two months and had noticed a lot of American steel foundries were using fireclay and bentonite mixed with the sand, and, in addition, one-quarter per cent. of a corn flour. It had been explained that it was used mainly to prevent the sand from drying and losing its moisture content too quickly; the bentonite gave the sand a better flowability for moulding and the fireclay was used for giving a better heat-resistance. It would be interesting to know whether anything of the kind had ever been tried in this country.

DR. ATTERTON replied that he had not done any investigations along those lines. The brief piece of research which he had described had been carried out in the odd moments during other work and unfortunately had of necessity been cut rather short, but he hoped that somebody else might be able to continue and investigate the numerous other variables which possibly influenced the magnitude of the expansion, and the tendency towards scabbing of a sand. Much information could perhaps be obtained by measuring the increase in elongation of a sand consequent upon additions of woodflour or pitch. If a sand were able to yield under stress rather than crack it should help considerably to remove scabbing difficulties.

Grain Size

MR. TIPPER said that, whether it was the expansion of the core or the facing, obviously scabbing must be linked with the strength of the bond counteracting the effect of the strain in the mass. He wished to know whether the work was being continued, and particularly of any work on the hot-strength of sand mixtures, which was a subject all foundrymen were interested in, so that they could begin to take action to improve their sands.

Towards the end of his Paper, Dr. Atterton, in referring to the effect of expansion, had referred to "well-graded sands," by which he presumably meant a wide distribution. (This point had been confirmed.) If founders were also to assume that the cracking of a wash was a result of differential expansion, then it might be expected that if a zircon sand base was taken and a zircon wash, very good results would be obtained. However, he had recently seen some work comparing zircon-base sand with silica-base sand in non-ferrous work both using the same zircon wash, and the results with the zircon mixture were worse from the point of view of cracking than the other, although it should be pointed out that it was not a simple, straightforward silica sand but a combination of silica sand and naturally-bonded sand. Possibly the mixture of grain sizes was better in one than in the other.

The Author had not mentioned the question of facing temperature, and the difference between the effect of penetration and fusing of the sand, which was probably all part of the same problem. If one got fusion one got very high strength and plasticity, and that might be another way round the problem of overcoming rupture of the surface when the refractories were expanding.

DR. ATTERTON, in reply to the point on penetration, said that in his previous experimental work on this subject, mould-washes had been tested at 1,600 deg. C. Mr. Tipper mentioned that fusion of the mould-wash would give very high strength, but it would also give a very high contraction; such fusion would in fact lead to a very large number of cracks in the wash surface. He was in agreement on the point with regard to the trouble with zircon sand but felt there would be probably less trouble with that than with the general silica sand. Finally, although he was not himself continuing with the work, it was part of a programme organized by the British Steel Founders' Association.

MR. JACKSON said that the work described by Dr. Atterton had really been carried out as a side-line to a major project upon which he was engaged for the B.S.F.A., but it was obvious that he had in fact started something of very much greater importance than had perhaps been anticipated. There was no question of the B.S.F.A. not continuing to sponsor this work in the future. He had been very pleased with the progress with this and the main work to which Dr. Atterton had referred, both of which, incidentally, had an important bearing upon the dust hazard in steel foundries.

Spraying or Painting

MR. SMITH enquired whether the Author had formed any opinion in his experiments as to which was the more efficient—spraying or painting of the mould-wash.

DR. ATTERTON said that in his laboratory scale experiments, his method of application of the wash had been to paint with an ordinary paint brush, but he felt that, in general, spraying would be better, in that it might enable one to get a certain amount of penetration of the wash into the pores. If, by means of spraying, the wash could be made to penetrate the sand, it would certainly help to reduce the extent of metal penetration.

THE CHAIRMAN. Mr. Colin Gresty, said that once or twice during the discussion the use of pitch had been mentioned, and the Author had referred to its use in ironfoundry work, but was it not also used in steel foundries?

DR. ATTERTON thought much of the trouble with pitch was from the point of view of "blows" and "gassiness," and that was the reason why it was no longer used in steel-founding.

MR. SMITH, reverting to the subject of the spraying and painting of the moulds, said that if one sprayed on the wash then one application was going to be much thinner than if it were brushed on.

THE CHAIRMAN, in proposing a vote of thanks to Dr. Atterton, said it would be the hope of the industry that either he or some of his colleagues would continue with what was undoubtedly very good work.

The vote of thanks was carried with acclamation.

Co-operation between Purchaser and Supplier*

Discussion at a Special Meeting of the Joint Iron Council

When the public meeting organized as part of the Annual Convention of the Joint Iron Council was opened for discussion, some customers of the industry voiced a number of complaints. Next followed appreciation of the conception of co-operative measures envisaged by the chief speaker, Sir Ewart Smith, and detailed proposals were made under a number of headings. Feeling among customers that a source of independent advice was necessary; the attitude of smaller firms to development; reluctance of users to accept trial materials; difficulties with specifications and the ever-recurring problem of co-operation with designers, all were put forward as factors affecting the desirable liaison.

MR. REID (Associated Portland Cement Manufacturers) said he had long wanted an opportunity to talk to the foundry industry because he had a very bitter complaint to make. He came from the cement industry and so was the ultimate user of the products of their foundries, and he wished to refer to his experience with castings for large gearboxes of 800 to 1,200 h.p. which were used for grinding mills.

The first four were ordered on behalf of an associated company in Mexico and, when the plant was put into commission there, one casting was found to be porous and the gearbox leaked oil. When the casting was examined, it was found to be porous over a large area, but the defect had been camouflaged by means of a compound. Every means of repairing the casting had been tried, but it had now been in service about three years and was still leaking oil badly.

Failure of Welded Defects

For the next ten boxes, different sizes and different makes, the castings were satisfactory. His firm then ordered four more 1,285-h.p. gearboxes, for which the centres of the high-speed wheels were iron castings about 8-ft. dia. When the first box was in course of manufacture, it was found that it was full of blowholes and scabs. However, as far as inspection could show, it was mechanically sound and, as the gearbox was wanted very urgently, the casting was accepted.

That gearbox had been assembled on site and put into commission but, owing to the rather doubtful first casting, they had opened the box and examined it thoroughly at the end of 12 months. The first wheel was in a satisfactory condition; no cracks had developed and, although it looked horrible, it was sound mechanically; but in the other wheel—number two casting—not only had large areas been welded and the welded areas were full of cracks, but there were large pieces of loose metal. One such piece, which he had brought along to the meeting, was three-quarters out of the casting, and if the gearbox had been run a few more hours, there might have been a major disaster.

He appreciated that the foundry industry, in common with all others, had trouble with bad workmanship, but founders had no business to try and deceive a customer. To the foundry, a casting was so many tons of iron, but to the speaker it represented so many tons of cement an hour, and at one time three, 1,285-h.p. gearboxes were out of service for some considerable time, and that had cost his firm between 11,000 and 12,000 tons of cement a week.

Specification and Consultation

MR. SYKES (David Brown & Sons, Huddersfield) said in his opinion Sir Ewart Smith had given members a very clear analysis of the subject which they were there to study, and had indicated broad lines. All agreed that research in itself was of no use unless it was put into practice. Research was simply looking for information and compiling it in an orderly manner: development was the next step, and consisted of making use of the information when once it had been obtained.

For general technical specifications, his firm found the British Standards quite suitable; they did not lay down the chemical analysis, and there were some special instances in which his firm had to specify certain limitations of chemical composition, but they had no difficulty in securing their requirements when they were unusual in that respect. With regard to consultation between designers and foundrymen he was bound to say that it did not take place very frequently. It would be an improvement if foundry salesmen could co-operate and be able to tell the customer something about the business of ironfounding. Sir Ewart Smith had emphasized the important position of draughtsmen, but unfortunately in very many cases draughtsmen looked upon that profession as a stepping-stone to something else, so that one did not often get draughtsmen of long experience. It would be better still if foundrymen could go forward and volunteer their ideas as to what should be done before the casting was made, because unfortunately the designer was very often in the position that he did not know what foundry would be undertaking the particular piece which he was designing. That only came later, when the buyer began to operate. Other aspects on which more co-operation was required included pattern-making, foundry methods, inspection, care of plant, fettling and cleaning and after-treatment, such as stress-relieving and rust prevention, and the speaker dealt with desirable trends in some detail.

* Opening speeches reported in last week's issue of the JOURNAL.

Independent Advice Required

MR. DREW posed a question which in his opinion had never effectively been answered. If, at the design stage, technical help from a foundry was solicited, his firm felt, from a purchasing angle, that they were more or less duty bound to place the resulting business with that foundry. However, in these days of competition, the foundry that was helping and co-operating with their design department did not always quote an acceptable price. He wondered why the foundry industry could not have a panel of independent people to whom firms could appeal at the design stage without feeling that they were tying themselves up to any source of manufacture. His firm had their own foundry and at the design stage their own foundry technicians were called in to assist in developing the design and in many cases they also had to produce the prototype, but it was still found that when that casting was put out for production in the foundry industry "one man's meat was another man's poison."

MR. WIZARD said, with regard to this last remark, that consideration might be given to the suggestion that whereas the British Cast Iron Research Association could not possibly handle all the design problems involved, they could, in conjunction with the Joint Iron Council, establish regional laboratories to which not only the local foundries could go with their daily problems but also where their customers could obtain advice before placing their orders with the foundries. Many small foundries had technical problems which were not being solved; the people who were getting their questions answered were the firms who could afford to instal their own laboratories.

Reluctance to Make Practical Trials

DR. EVEREST said that Sir Ewart had presented a very intriguing triangular diagram, but a point in the development of high-duty irons seemed to be missing. That was that one could give designers data on new materials, but there was a great reluctance to adopt some of the new irons until there was more practical experience; in other words the user and the designer were lacking in confidence until somebody else had tried the material. Dr. Pearce and the Research Association could go a long way towards developing data on the new irons but there was something the laboratory could not do, and that was to determine the behaviour of the iron in service. There were questions such as wear and erosion on which laboratory tests did not give the answer and, unfortunately, in this country the tendency was to let somebody else make the trials, which held back development.

British Castings Preferred

MR. E. LACY-HULBERT said that his firm had been buying castings for over fifty years and right up to the period just prior to the last war if they had wanted to be sure of a really good casting they went to Belgium for it. Immediately after the war, when castings were hard to get, they went back to the Continent, but they had only placed one order and there had been no repeat orders since. He had been a little distressed to learn that the gathering consisted of what he termed "self-interested" foundrymen of the big foundries. There should be no need to stress that manufacturers of various machined products depended a great deal on the smaller foundry and the man who would take enough interest to make a few specialized castings which did not warrant plate moulding. Nevertheless, his experience was that some of the smaller foundries were not going ahead as fast as the bigger ones, with at least some mechanization, and therefore they were inclined to carry on in the old steam-engine fashion, which was not adequate under present circumstances. His firm was not in a big way of business but they were always ready to listen to a request from any foundry they might employ to be allowed to alter the pattern in order that it might be produced in a more economical way.

So far, that afternoon, no one had made any serious reference to price. Admittedly, as far as castings were concerned, the first consideration must be quality, but he hoped the audience would not concentrate entirely on the quality and forget about price. He had just returned from the International Trade Fair in Zagreb, and he had been horrified there at the paucity of the British exhibits and the things he had heard about prices. What engineering business did not to some fairly large extent depend upon the casting as the basis of its product?

In his experience, the average foundry did not think about service. If a casting was bad and one wasted a lot of machine time on it that was very unfortunate, but the foundry provided another casting. Did they really think it was good business to be satisfied with simply replacing a casting which had been proved a waster, and leaving it to the customer to pay all the expense of finding out their mistake? Within the last ten days, his firm had received a batch of crank-case castings weighing about 2 cwt. each for three-stage compressors, which had to withstand a working pressure of 3,500 lb. per sq. in. When the first was on the boring mill, a very astute operator had asked whether he should go on with it, for just apparent to the naked eye was the slightest trace of a hair crack. They took it down and tried the next one and found the same thing, and so on throughout the whole batch. They got into touch with the foundry and asked whether, if they sent back the ones which had not been machined, the foundry had any means of examining them in order to tell whether or not they were perfect. The answer was "no," and they were unable to say where it could be done. In his opinion, a foundry should know that each casting they sent out was crack-free. They should have the apparatus available for ensuring that they were giving the customer a first-class article, which meant giving him some service as well as just a casting.

He wondered to what extent moulders, and possibly charge-hand moulders and foundrymen, visited their customers to see what they did with some of the castings. Surely it would be of some

advantage both to the foundry and the customer if, during the course of time, some of the key-men who were constantly producing castings could go and see what they were going to be used for and what the disadvantages were of certain porosity, or core-sand which might be left in.

MR. LUCHFORD said he could sympathize very largely with the users of castings because his firm both made and used them. He believed people in the foundry industry were like mother cooking the cake: she could take all the trouble possible in mixing the ingredients and with the temperature of the oven, but until she ultimately put the cake on the table and cut it it was impossible to tell whether it was going to be a success. He would like users of castings to understand what the founders were really up against.

Modifications Refused

MR. AINSBURY said that apart from being in the iron trade he was also in the die-casting trade, and has recently had an interesting experience on the question of co-operation in design. All the speakers so far had suggested that the designer was always willing to co-operate with the foundry, but he had recently received an enquiry from a very prominent firm of motor-car manufacturers which proved the reverse. The foundry had prepared a quotation and the manager of the die-casting foundry suggested a very slight modification which would reduce the cost. Instead of being thanked for his efforts he was turned out of the office, having been told "We are (so-and-so); we design motor-cars and we ask you to make castings," the inference being that they would never have any more enquiries from that particular firm.

Specification Difficulties

DR. ANGUS said it had appeared from the discussion that some of their user friends still regarded the blowhole as the essential cavity around which the casting was poured, but in spite of that fact they still came back for more! There were one or two points to which designers were sometimes rather blind; it was not entirely their own fault, because cast iron was a particularly complex material. A designer, when he specified a particular cast iron for a job, might ask himself three simple questions: What were the extremes of service to which that casting was going to be put, what were the properties actually required, and were all those properties mutually consistent?

Those three questions had to be put if a specification was going to be useful. To take one simple example, that of the brake-block or brake-drum which was used in the railway industry, in the aircraft industry and in the automobile industry. He had seen specifications for brake drums which called for a high-tensile iron of 17 or 18 tons per sq. in. Suppose the designer asked himself instead "What do we require in a brake drum and what are the stresses involved?" If one took an aeroplane weighing thirty-five tons, with a touch-down speed of one hundred miles an hour, and it had to stop within sixty seconds, the only way to do that was to dissipate the energy in heat, and that heat had to be absorbed in something. The only thing at the moment which would absorb that heat satisfactorily was cast iron. The brake of an aeroplane of that weight was not stressed in tensile at all—a tensile strength was valueless. Again one could take a grade 17 iron which could have a total carbon content of 3.4 or 2.8: the latter might be unsuitable as a brake material whereas the former was satisfactory. An important thing to ask when one laid down a specification was "Does it specify every property except the one that we want?"

Circulation of Personnel

SIR EWART SMITH, replying to the point raised by Mr. Sykes in connection with draughtsmen, wished to make it clear that his "key-man" was not necessarily a draughtsman—he referred to the best technical man obtainable, who might be a university graduate. His own feeling was that in this country the foundry industry had neglected to get a proper proportion of really well-trained and inquiring minds from universities or technical colleges. He did not particularly want Ph.D.'s—all he was concerned with was what a man could do. Had he been trained to think? Had he been trained to understand scientific knowledge? A great deal had been said about research having contact with production: one should move people from research to production and back again—it was by moving men that one spread ideas and progress, rather than by having a research association sending out reports.

The CHAIRMAN (Mr. N. P. Newman), closing the proceedings, said the day had been of benefit, particularly to the ironfounders, in hearing at first hand some of the views of their user customers. Without knowing details of some of the castings described, he had naturally wondered whether design had something to do with the troubles, and also in relation to the pressure-resisting casting in which hair cracks were detected.

Much had been said about what could be called "additional service" to be given by ironfounders to their customers. Subject to their having sufficient capital, founders could supply all castings annealed, shot-blasted, guaranteed crack-free and protected against rust, but it cost more money, and he wanted to be quite sure that, having done all that, the buyer would be able and willing to pay more for the casting. A good deal of education was required for the buyers, who so often bought the cheapest thing they could get, hoping that it would fulfil the function required of it, without consulting either the designer or the actual user.

He fully endorsed the suggestions which had been made with regard to visits by foundrymen to the users' works in order to see what happened to the castings, but it should be a two-way traffic, and men from the machine-shop should visit the foundries in order to appreciate their difficulties.

Public Works and Municipal Services Exhibition

Foundries well represented in Mammoth Show at Olympia, November 3 to 8

Last Monday, Mr. Harold Macmillan, Minister of Housing and Local Government, opened the imposing Public Works and Municipal Services Congress and Exhibition at Olympia. Here some 30 foundries display their products, ranging from dainty name-plates up to mammoth excavators, cranes and washery plants. Additionally, of course, there were incorporated castings made by non-exhibiting foundries, some of which were of excellent finish, but a few, especially among the heavy steel castings, whilst serviceable, did not reach "exhibition" standard. Where actual foundries were showing—and they included makers of municipal castings, road signs and name-plates—the quality was impeccable. The exhibition, which closes on Saturday, includes some of the largest pieces of plant ever shown at Olympia, and would seem—on account of the heavy cost of installation—to warrant a longer period of showing. Yet one supposes the number of potential buyers is limited.

Stress is laid at this exhibition on the progress made post-war in the field of earth-moving equipment and the application of this plant to works excavation, site levelling, storage and transport of bulk materials, all of general interest for founders. Mobile cranes comprise one group well represented and these are being more and more adopted for moving moulding-boxes and other plant and materials in iron and steel works' stockyards. Even the humble wheelbarrow has been equipped with a motor and been given increased capacity without sacrifice of manœuvrability and general usefulness. It is on these lines that founders are urged to view the 250 stands covering 235,000 sq. ft. of space at Olympia.

Stand Details

From sheer weight of numbers, as on previous occasions, tractor and bulldozer stands steal the show and, amongst foundry producers of this type of equipment, three crawler tractors and Diesel models are shown by the INTERNATIONAL HARVESTER COMPANY OF GREAT BRITAIN, LIMITED, in conjunction with scraper and bullgrader equipment.

DAVID BROWN TRACTORS, LIMITED, Meltham (Yorks), are showing the Trackmaster "50" industrial tractor with F-type power-control unit, fitted with Blaw Knox angledozer and 4-cub. yd. scraper.

MARSHALL SONS & COMPANY, LIMITED, Gainsborough, and JOHN FOWLER & COMPANY (LEEDS), LIMITED, show a selection of crawler tractors and road rollers.

NEWTON, CHAMBERS & COMPANY, LIMITED, Thorncliffe, Sheffield, show the latest addition to the range of NCK excavators and cranes—Model 605. When equipped as a shovel it has a dipper capacity of 1½ cub. yds. and is available with dragshovel (1¼ yds.) and dragline (up to 2 yds.) attachments. Model 605 is quickly convertible for crane duty.

A Diesel-engine-driven mechanical excavator, mounted on caterpillars and designated the 22-RB, is the feature of the RUSTON-BUCYRUS, LIMITED, exhibit.

RANSOMES & RAPIER, LIMITED, are exhibiting machines from their range of excavators, mobile cranes, and contractors' plant.

At the BRUSH ABOE group stand, a display of petrol and Diesel engines is featured from Petters, Limited, McLarens, Limited, National Gas & Oil Engine Company, Limited, and Mirrlees, Bickerton & Day, Limited. The National Gas and Oil Engine Company exhibiting its six-cylinder engine, which is an example of the "M4A" series designed for heavy duty and particularly suitable for earth-moving equipment installations.

A cinema is included in the STANTON IRONWORKS COMPANY'S stand and visitors will be able to follow the manufacture of some of the company's major products. The varied exhibits include the Stanton series of joints (flexible and non-flexible) for cast-iron pipes, and tees, syphons, and special castings, together with a pyramid of the company's range of spun-iron pipes in diameters of 3 in. to 27 in. There are shown, in addition, samples of dry slag, pig-iron, and refined iron. A spring cut direct from a length of spun-iron pipe is incorporated in a demonstration of the flexibility of the Stanton screwed-gland flexible joint

Prominent on the GEORGE COHEN SONS & COMPANY, LIMITED, stand is the Jones KL 15 mobile crane, which has a maximum lifting capacity of 15 cwt. It has been developed to meet the demand for a powerful, manœuvrable unit to do the odd jobs of lifting, shifting, and stacking where the use of larger cranes is impracticable or uneconomical.

An extensive range of compressed air plant and equipment forms the basic display on the stand of the CONSOLIDATED PNEUMATIC TOOL COMPANY, LIMITED.

WINGET, LIMITED, Rochester, are showing the Winget Mechanical Moke power barrow, a highly manœuvrable powered barrow with instantly interchangeable skip and platform. It cuts out costly hand-barrowing in the foundry and many other industries.

THOS. W. WARD, LIMITED, Sheffield, has a group of exhibits representing the company's many interests in the field covered by the exhibition. A 5-ton steam loco crane with 45-ft. jib is typical of the plant available to contractors for hire or purchase. Plant and machinery shown include conveyors, hoists, concrete mixers, compressors, pneumatic tools, pumps, saw benches, and loaders.

HOLMAN BROS., LIMITED, Camborne, have an exhibit consisting almost entirely of compressed-air plant and show something of the many uses made of this convenient and flexible medium of power transmission. Among the different forms of drill mountings will be the "Airleg," which is used extensively in civil engineering as well as in mining.

THE DOMINION RUBBER COMPANY, LIMITED, are showing conveyor belting, air, water, delivery and suction hose for use on contractors' sites, and rubber flooring.

THE BRITISH IRON AND STEEL FEDERATION have an exhibit designed to provide a centre of information, particularly on the iron and steel scrap drive.

W. & T. AVERY, LIMITED, Birmingham, are exhibiting a compression testing machine for crushing

Public Works Exhibition

tests on concrete cubes, and a cement testing machine for standard test specimens.

Compressed-air equipment for municipal engineering and public works contracting, comprising a full range of breakers, picks, diggers, grinders, etc., is being shown by ARMSTRONG WHITWORTH (PNEUMATIC TOOLS), LIMITED, Newcastle-upon-Tyne.

Narrow-gauge Diesel locomotives, shunting locomotives, Diesel engines, and boilers are shown by RUSTON & HORNSBY, LIMITED, Lincoln.

An extensive range of pneumatic tools and of compressed air accessories will be shown by JOHN MACDONALD & COMPANY (PNEUMATIC TOOLS), LIMITED, Glasgow.

On the stand of the CLIMAX ROCK DRILL & ENGINEERING WORKS, LIMITED, Redruth, the Climax wagon drill, which is becoming increasingly popular in quarries where the merits of deep hole drilling are appreciated, can be examined in detail. Among many other exhibits one of the most interesting is the small display of "Maxam" equipment widely adopted as a means of speeding output in factories.

STOTHERT & PITT, LIMITED, Bath, are exhibiting a range of concrete mixers, vibrating rollers, and other contractors' plant.

A selection of the well-known Lister petrol and Diesel engines, which are used for a wide range of industrial applications, are to be found on the stand of R. A. LISTER & COMPANY, LIMITED, of Dursley.

W. H. DORMAN & COMPANY, LIMITED, Stafford, are showing units from their specialized range of Diesel engines for industrial and power purposes.

British Compressed Air Society

Between 70 and 80 delegates from member firms of the British Compressed Air Society recently made a two-day visit to Birmingham to take part in another very successful "works visit," where they were entertained by Belliss & Morcom and the Hymatic Engineering Company.

The Society could scarcely have chosen two more appropriate organizations to illustrate the extremes of the compressed-air industry's size of products and type of production. In the heavy-engineering workshops of Bellis & Morcom, the visitors saw on the first day the production arrangements for large steam engines, steam turbines and giant stationary air-compressors up to 5,000 cub. ft. capacity. The next day brought complete contrast in a journey round the works of the Hymatic Engineering Company, of Redditch, where the visitors saw the manufacture of 1.4 cub. ft. high-pressure compressors weighing no more than 10 lb.

Osborn Foundry Centenary

To commemorate the centenary of the parent Company, the employees of Osborn Foundry & Engineering Company, Limited, Rutland Works, Sheffield, on October 23, presented to the Board of the parent Company, Samuel Osborn & Company, Limited, a chairman's chair which matches in design the existing furniture in the Company's boardroom. It bears the Company's "Hand and Heart" corporate mark on the head and an inscribed plate at the back. Mr. F. A. Hurst, chairman of both Companies, accepted the gift on behalf of the Board, saying that he regarded it as a mark of the loyalty and community of interest which had built up the Osborn organization over the last century.

Censuses of Production for 1952 and 1953

An Order indicating the scope of the Census of Production to be taken in 1953 for the year 1952 has been made by the Board of Trade. Undertakings producing coal, gas, electricity, oil shale, crude or refined petroleum, or shale-oil products are exempted from making returns to the extent to which they supply the necessary information to the Minister of Fuel and Power.

As previously announced, sampling will be used in the census for 1952 for the first time. The use of sampling methods is facilitated by the fact that details of output and the usage of certain materials were obtained in the census for 1951. This information could not be obtained in the census in sufficient detail by sampling methods, owing to the complexity of the national industrial structure. The adoption of sampling methods will relieve a large proportion of the smaller and medium-sized establishments of the need to make a return. Moreover, fewer questions will be asked than in any previous census. In sum, therefore, there will be a very considerable reduction in the demands made by the census upon industry.

The census to be taken in 1954, in respect of the year 1953, will be on the same simplified basis as that adopted for the previous year. The decision to take a simplified "sample" census for the second year in succession has been made after consultation with the Census of Production Advisory Committee. The censuses for 1952 and 1953 will cover all producing industries and returns will be required from all firms over a certain size in each trade. From the information obtained, early estimates will again be made of certain important aggregates such as total sales, materials used, stocks, and capital expenditure for each trade.

The statutory form of return for both years will include questions on working proprietors; average employment during the year; wages and salaries; plant, machinery, and vehicles; new building work; total materials and fuel purchased; work given out; stocks at the beginning and end of the year; total output, and transport payments.

The following are the principal simplifications, compared with the census for 1951:—*Output* (*sales*), total only; no detailed analysis. *Materials purchased*, total only; no detailed analysis of usage. *Employment*, no detailed analysis; average number of operatives and of administrative, technical, and clerical employees. *Wages and salaries*, no details of payments to outworkers or national insurance payments.

Further details of the statutory form for the census to be taken in 1954 for 1953 will be sent to trade associations as soon as possible. Any firms in the field of production requiring further particulars about the census for 1953 should write to the Census of Production Office, Neville House, Page Street, London, S.W.1.

Steetley's Canadian Subsidiary

The Steetley Company, Limited, Shireoak, Worksop (Notts), has formed a subsidiary in Canada, Steetley of Canada, to develop dolomite refractories. A $3,500,000 undertaking, of which $2,000,000 will be spent on construction and equipment of plant at Dundas, Ontario, is planned.

At present Canada depends on the U.S. for supplies of burned dolomite refractories. It is hoped that, with increased steel production, the Canadian industry will absorb the output of the domestic rotary kiln planned by the Company in Ontario.

Production Methods in the Enamelling Shop

In common with most other producers at the present time, the writer's company has been successfully enamelling steel, both of the best quality obtainable and in some cases what appeared to be the very worst, and as a result of this, useful information with regard to the processing of these varying grades has been obtained. Regarding cast iron, the company is in a much happier position and is able to control within very close limits the iron required for enamelling, and to carry out the very desirable steps regarding thickness, contour, edges, etc., so that everything is prepared for the enamelling shop in the best condition. Moreover, the closest liaison is daily maintained between the foundry and the enamelling shop through foremen and charge hands, and any difficulties which may arise can be immediately cleared up.

In connection with the ironfounding procedure used, the pattern equipment is of the best possible, and the majority of patterns are made in aluminium with a well-polished surface. All patterns are used face downwards in the drag of the mould, double-sided pattern plates produced in the company's patternshop being used throughout.

A rigid control of the sand is maintained and a facing sand consistent in mixture is plentifully supplied for the moulders, the mixture used being:—Erith medium, 1¾ cwt.; Erith strong, 1¾ cwt.; floor sand, 5¼ cwt.; coal dust, 34 lb. The coal-dust is of superfine quality and the above quantities represent one batch which is mixed and mulled in a batch-type muller.

Facing sand is sieved on to the pattern through an ¼-in. mesh sieve, after testing to keep within the following limits of moisture:—7.5 per cent., using a "Speedy" moisture test; permeability (A.F.A. method), 24.2; green-compression strength, using B.C.I.R.A. machine—5.2 lb. per sq. in. The moulders' floor and backing sand is tested regularly to see that the silt does not build up and this sand is kept in condition by addition of new sand as required.

Metal Control

Metal control is of the highest importance. A 6-cwt. charge is used consisting at present of:—Pig-iron, 2 cwt.; light scrap, ¾ cwt.; medium scrap, 1 cwt.; shop scrap (*i.e.*, runners and bed), 2¼ cwt.

Each part of the charge is weighed and placed in the charging barrow which takes also a basket of coke weighing 67 lb. and a tin containing 12 lb. of limestone. The barrows are charged into the cupola, by hand, in the same order, thus ensuring an even mix.

Close analytical control is kept and the average analysis, per cent. is in the range of:—T.C, 3.22; graphitic C, 2.62; combined C, 0.60; Si, 2.80; Mn, 0.62; S, 0.08; Ni, 0.20. Silicon is kept to 2.80 per cent. by the addition of silicon briquettes to the charge, the number varying according to the quality of pig-iron available. Manganese is kept at 0.62 per cent. by the addition of silico-manganese briquettes added to the charge. The nickel appears through the runner returns of iron which has a nickel addition made at the spout. "F" nickel shot is used for this purpose. Due to the varying pig-irons available in these difficult times, some variation in analysis inevitably appears from time to time.

The enamelling shop is very much kept in mind when castings are produced and there would be little excuse for failure due to bad iron and, in fact, complaints of this nature are virtually non-existent.

Preparation

It may be well at this point to return to preparation for enamelling of cast iron; this is treated by shot-blast in a room-type blast with dust-extraction plant and three separators. The large shot separator is regularly emptied and returned for re-use. An air pressure of 70 to 80 lb. per sq. in., using a ⅜-in. bore nozzle, is used and for cleaning purposes No. 16 grade angular steel grit, together with approximately 20 per cent. silica-free grit. This mixture has proved to be the greatest asset to the surfacing of castings for enamelling, as a fine film of grit is left on the face of the castings, instead of the usual carbon sludge left when steel shot is used alone. This film needs no removal prior to spraying and in practice the result obtained completely eliminates all blistering and boiling on the fused article.

A proprietary alkaline cleaner is used in the preparation of sheet-steel articles with a concentration of 6 oz. per gallon kept at boiling point and agitated; the immersion period is 20 minutes followed by a cold-water rinse. Cold hydrochloric acid with a concentration of one part acid to two parts water, with an immersion period of 15 to 20 minutes, is again followed by a cold-water rinse.

The neutralizer used is soda-ash solution, the concentration being 4 oz. per gallon with an immersion period of 5 minutes, followed by a boiling borax solution, concentration ½ oz. per gallon with an immersion period of 2 minutes; then on to a hot-plate dryer, after which the parts are available for dipping or spraying as required.

Milling of Enamels

It is not much use paying great attention to the castings nor endeavouring to select the best grade of steel suitable for enamelling if great care is not exercised in the actual milling and preparation of whatever frit may be used.

Production Methods in the Enamelling Shop

The writer is fortunate in having a well-equipped mill room with equipment ranging from 1,000-lb. mills to experimental pot mills, the battery consisting of 12 mills in charge of first-class operators. Here the materials are ground at fairly low speeds over periods ranging from 12 to 18 hours. There is no doubt, from experience, that slow grinding ensures quality batches of enamel which can be repeated and uniform colour and consistency maintained.

All mill charges are accurately weighed and checked by the loader and again checked by the chargehand before loading into the mills. Enamel fineness testing is to the standard 50-cc. sample washed on a 200-mesh screen; the residue left is then dried and measured. All enamels after unloading are passed through a vibrating sieve with a magnetic separator incorporated, and then passed into storage bins where at least 24 hours elapse before usage. Mill batches are checked on a fired sample plate, a check is then made for colour, opacity, adherence and acid resistance, before permission to issue to application sections is given.

Spraying and Dipping

Enamel is applied by cup guns at a pressure of 40 to 55 lb. per sq. in. according to the type of enamel used. All enamels are issued from the mill room to a specification and tampering, *i.e.*, by dilution or otherwise, after issue is strictly forbidden.

For cast iron a spray gun is used with a 4½- to 5-mm. nozzle which deals with enamels of a consistency of 38 to 40 oz. to the pint and an endeavour is made to cover to a thickness of 0.014 to 0.016 in. for a one-coat direct finish. All light castings are sprayed by direct application but larger castings with heavy lugs, etc., may have a very thin matt groundcoat as a first application.

For sheet-steel groundcoats and cover coats a spray gun with a 2-mm. fluid nozzle is used; groundcoats are sprayed to a thickness of 0.005 to 0.006 in. and cover coats of titanium enamels are applied to the extent of 0.003 in. making an overall thickness of 0.008 to 0.009 in.

Groundcoats of enamel slip for dipping are issued to required consistency by the mill room chargehand, who checks the slip every two hours during the day and adjusts if necessary. A 12-in. by 12-in. check plate is used and a 1½-oz. dry weight on the plate which gives a 0.005-in. thickness on the fused article, is aimed at. Dipping tanks are situated at the rear of the furnaces and the dipped work is fed into drying rooms which lie between the sides of adjacent furnaces. When dry the work is unloaded on the sides of furnace loading forks.

General Drying

Room-type dryers are used for spray work, heated by the waste heat from furnaces *via* the recuperators mounted in the stacks. From here the heat is blown into the dryers. Heat in the drying rooms is circulated by a fan mounted on top of the room. Temperature for sheet-steel drying is 180 deg. F. for 15 to 20 minutes for groundcoat work and 6 to 10 minutes for cover-coat work. Temperature for cast-iron drying is 250 deg. F. with a drying time of 20 to 30 minutes.

Cleaning and Edging

This process prior to fusing is done on a machine of the company's own design, which essentially consists of a polishing head with an 8-in. hard felt bob. This felt is cut down to whatever size edge is required up to a width of ¼ in. Incorporated in this machine are bolt-hole felts of ⅜ to 1¼-in. diameter. The speed of the machine is 1,400 r.p.m. This machine also has a dust extractor to comply with the Factory Acts. It has been found that the use of this machine has increased edging production by more than 200 per cent. over normal hand methods.

Fusing

This operation is carried out in box-type muffle furnaces. The writer does not propose at this stage to enter into any discussion regarding the merits or demerits of continuous furnaces and box furnaces, but muffles have proved to be most satisfactory for normal requirements, on account of the flexibility of a small number of box furnaces as opposed to other types.

The furnaces used are 12 ft. long and have Carbofrax combustion chambers. They are oil fired and the consumption is 6 to 8 gallons per hour, depending on the temperature required. Each furnace has a double-loading fork and is equipped with pyrometers and process timing clocks.

As far as possible a separate furnace is used for each operation, *i.e.*: One muffle is used for cast iron with a temperature ranging from 740 to 760 deg. C. A second muffle for sheet-steel groundcoat for cover-coat work, with a temperature ranging from 860 to 870 deg. C. A third muffle for sheet-steel groundcoat and groundcoat and mottled finished work, with a temperature of 880 to 890 deg. C. A fourth muffle for cover-coat work with a temperature of 810 to 820 deg. C.; in this muffle, transfer work is also fired. A fifth muffle for cast-iron normalizing of small castings of intricate section and fusing of matt coats, etc. Finally, there is one standby muffle, making six in all.

By this method it is possible to keep a stabilized temperature in the muffles which is good practice for quality work and also prolongs the life of the brickwork, thus reducing the loss of production through repairs. Muffles are never shut down except for repairs

In practice no castings are annealed. Hob tops with a large area of plane surface are wet ground and the dampness is taken out of the casting in the dryers normally used for drying enamel ware.

At this point readers may well imagine that there is nothing new or novel in the methods used for handling work, and to a large extent this is true, but the following methods have been adopted either by desirability or force of circumstance.

Inspection

One of the most important changes made in the department is the elimination of the final inspection by independent control. It has been found that this inspection caused a serious bottle-neck in the department's output, and also resulted in what appeared to be a predetermined percentage of rejections. This reflected seriously on supplies reaching assembly departments.

The process and final inspection now adopted is entirely the enamelling department's responsibility and all workers are required to reject at any stage any imperfect processing. This has greatly improved the morale of the enamelling department employees and has freed them from the feeling that in any case a percentage of their work was bound to be rejected. The result is that rejections have fallen to a very low percentage indeed and scrap due to rejections practically does not arise.

Work is sent out for de-enamelling, but in general this arises from the repair and service departments more than from the enamelling department. As regards cast-iron work, the only rejections are due to fractures and occasional distortion.

Process inspection is carried out by men of experience and all castings and steel parts are inspected after cleaning operations; dirty work is returned to sandblast or pickling shops; damaged or defective parts are sent to the department's repair section. (This section will be referred to later.)

All groundcoat work for cover coat is inspected from the furnaces directly it is cold; any repair work is done immediately and the ware is refired. All ware for cover-coat spraying is passed to the spray section and processed. All ware in the department is progressed through with the minimum of delay as personnel realize that even one article left for any length of time without attention is liable to become scrap.

In the shop is employed, as a responsibility of the enamelling department, a sheet-metal worker who is also a skilled welder. He is on hand to repair immediately any obvious defects of parts for enamelling. These defects may come through transit damage or other reasons, but whatever they are he deals with them and so eliminates the necessity for sending the parts on a long journey to the makings department and back, again risking still further damage. This repair man is also responsible for the manufacture of special pattern burning tools required. There are many types of these tools tailor-made to suit the particular shape of the ware, and these in turn have helped to cut down scrap due to distortion.

Final inspection is carried out by an operator with over 20 years of service in the vitreous trade. Ware is inspected and cover-coated work is then put into protective bags and passed to the stock room. Any rejects are clearly marked with the fault and returned to spray or furnace sections to be put right. Here again it is imperative not to allow the article to remain stationary, otherwise it may become scrap.

In addition, in the vitreous-enamelling department there are drilling and tapping machines which are used for clearing and retapping holes after enamelling. These machines and their operators are part of the department and work with the same view as all the other men, *viz.*, that a part received in the department shall not leave it until it is in fact ready for assembly, and in addition to being a satisfactory enamelled product, it shall also not need attention elsewhere.

Conclusion

These changes in the department relative to inspection, sheet metal repairing, drilling and retapping, have cut down the scrap to a very low figure. It must not be thought that by the abolition of independent inspection inferior work has either been condoned or assembled. So far from this being the case the final finish is, without doubt, improved, and an important factor is that all the workers in the vitreous-enamelling department are contented at their work, earn good wages, and know they are all judged on the care with which they process parts in their own department. In fact they work as a team.

To sum up—experience has proved it is useless to give great attention to materials if the psychology of the worker in the department is not studied.

I.V.E. Visit to Watson House

During the recent annual general meeting, 46 members of the Institute of Vitreous Enamellers visited the Watson House premises of the North Thames Gas Board and particularly viewed the permanent exhibition there. This exhibition portrays, broadly, the efficient use of the products of the carbonization of coal, with particular emphasis on the provision of domestic fuel services. In doing so, it sums up much of the work of the Watson House laboratories which have for many years been concerned with research on the utilization of gas and coke for domestic and industrial purposes. The function of these laboratories is the improvement, in its broadest sense, of service to consumers by developing and sponsoring increased efficiency of appliances and reduced installation and maintenance costs.*

The exhibition is self-contained and exhibits are arranged in the following groups: (1) Aims of the gas industry; (2) the fuel problem; (3) old and new standards of domestic heating service; (4) latent wealth of coal; (5) progress and expansion of the gas industry; (6) gas manufacture and distribution; (7) meters and installation pipes; (8) domestic gas and coke appliances; (9) kitchen planning; (10) industrial and commercial uses; (11) domestic and industrial controls; (12) ventilation and flues; (13) quality control of appliances and stores; (14) planned heat services; (15) training and (16) research and information. In addition to seeing all these, the Institute visitors made a tour of the laboratories themselves, where domestic and industrial gas and coke appliances are developed and tested. Particular emphasis was given to the importance of vitreous-enamel finishes to domestic appliances and to the tests to which these finishes are subjected. Finally, the part that gas plays in the application of enamel finishes was shown in a demonstration of frit drying in an infra-red radiant-heat tunnel, preparatory to firing, as well as illustrations of various types of enamelling furnaces and an exhibit showing a method of de-enamelling.

* See also, "Gas-appliance Users' Demands from the Enameller," by E. W. B. Dunning, B.Sc., Proc. I.V.E., v. IX, p. 19.

Free Trading Restored in Ferro-alloys

The Minister of Supply, Mr. Duncan Sandys, has decided to restore the right of individual manufacturers and merchants to import and distribute all ferro-alloys without exception.

For some years past, licences for the importing of certain important types of ferro-alloys have been granted only to the Central Buying Organization of the British Iron and Steel Federation (B.I.S.C., Limited), which, under arrangements agreed with the Ministry, has bought in bulk and acted as distributor to all users in the United Kingdom. As a result of the Minister's decision, licences to import all such ferro-alloys will, as from January 1, 1953, be issued to individual firms as well as to B.I.S.C., Limited. This relaxation of control has been made possible by the improvement in supplies.

The alloy metals affected are:—Ferro-silicon, ferro-chrome, ferro-silico-chrome, silico-manganese, silico-spiegel, ferro-phosphorus, and calcium silicide. Applications for import licences should be addressed to the Board of Trade.

With the turn of the year, copper will be the only major non-ferrous metal in which business is normally transacted on a free market remaining under Government control. It is about three years since freedom returned to trading in tin; lead was freed a few weeks ago and, all being well, free trading in zinc will be resumed on January 1 next.

Prospects for the return of free trading in copper are less bright than they were. Much will depend on developments in Northern Rhodesia; the strike in the copper belt there would be serious for the United Kingdom if it continued for any long period. An early settlement, however, might well mean that the British Government would feel disposed at the end of this year to give to Commonwealth copper producers six months' notice of its intention to end the bulk-buying of the metal. In this event, private trading in the red metal could be resumed on the London Metal Exchange on July 1, 1953.

Aluminium Diverted to the U.S.A.

Because of "the serious loss of aluminium production in the United States caused by power shortages in the Pacific North-West and Tennessee Valley," the U.S. Government has made an urgent request to the British Government for assistance, and it is announced that the British Government and the Aluminium Company of Canada have agreed to supply the United States with an additional 77,000,000 lb. of aluminium for delivery during December, 1952, and the first half of 1953.

The total is derived from an additional diversion in December and during the first quarter of 1953 of 44,000.000 lb. under contract for shipment to the U.K., plus 33,000,000 lb. which were to be returned to the U.K. under the terms of similar arrangements made in 1951 and early this year.

The Ministry of Materials explains that the decision to make this aluminium available to the U.S. was reached after a careful review of requirements in this country. The Ministry is satisfied that supplies will be sufficient to meet U.K. needs.

A SEVEN-DAY SCRAP METAL DRIVE at Stafford has brought in a total of 111 tons of scrap.

Metal Finishing Institute's Activities Extended

The Institute of Metal Finishing is to extend its activities to cover the field of organic finishing generally, it was stated at the Institute's annual general meeting in Birmingham recently. A delegate committee as representative as possible of the industry, is to be appointed to organize a conference in the near future, at which an organic group will be founded.

At the inaugural banquet of the Institute held the same evening, Lieut.-General Sir Thomas Hutton, general manager of the Anglo-American Council on Productivity, urged the pooling of information between firms in the metal-finishing industry. The less the more advanced firms were prepared to share their knowledge with others, the worse for the industry as a whole, he said, but it was very often small firms which got hold of new ideas. He did not suggest that firms should give away discoveries, but only that they should share experience.

Mr. H. Silman, president of the Institute, said that it might prove better to produce smaller quantities of very high quality goods than to turn out great quantities by mass production. "Let us leave mass production to the Japanese," he said, "and concentrate on the production of an aristocracy of goods. To do that we must pay a great deal of attention to the question of finishing."

Shipbuilders Still Need More Steel

Speaking at the launching of the first of six refrigerated cargo liners which are to be built by John Brown & Company, Limited, Clydebank, for the New Zealand Shipping Company, Limited, Dr. J. McNeill, managing director of John Brown & Company, said that the recently announced 9 per cent. increase in the steel allocation was still insufficient for shipbuilders' requirements. He declared that steel for the fourth quarter of this year was supposed to be 8 per cent. above that for the third quarter; to meet shipbuilders' requirements that 8 per cent. should have been 50 per cent.

Stressing the importance of building ships to serve under the British flag as well as for export, Dr. McNeill urged that shipping should be given a higher degree of importance in the country's economy. If the earnings of a tanker were compared with the earnings obtained by the export of steel as raw material, it was found that the earnings of a large tanker in 12 months amounted to about £750,000. To export the same quantity of steel, *viz.*, 8,000 tons, whether as raw materials or as the finished products, at prices which varied between £50 and £100 per ton, it was necessary always to take the highest figure of £100 per ton before a comparable figure could be reached.

More Steel for Factories

Steel allocations for licensed factory building for the first quarter of 1953 are to be increased by about 15 per cent., and the Government is confident that it will be possible to maintain the allocations at their increased level throughout 1953. By such means it is hoped to restore a substantial part of the cut in capital investment made a year ago.

The increase of 15 per cent. represents the total increase of the allocation of steel by the Ministry of Materials to all the departments concerned—the Ministry of Supply, Board of Trade, the Service departments, Ministry of Education, and Ministry of Agriculture. It is for these departments to make the sub-allocations to the holders of licences.

Personal

MR. NORMAN G. ALLEN was elected chairman of the Eastern Branch of the Institution of Mechanical Engineers at its inaugural meeting held in Bedford.

MR. J. W. BECK, secretary of John Brown & Company, Limited, has been appointed a director of the firm following the resignation of SIR DONALD SKIFFINGTON.

MR. ARCHIBALD FLEMING, head foreman engineer (outside) of the Fairfield Shipbuilding & Engineering Company, Limited, Glasgow, has retired after 51 years with the firm.

MR. H. HAMPSON has had conferred upon him the title of Reader in Mechanical Engineering at London University, in respect of the post held by him at Queen Mary College.

MR. JOHN H. COTTON, deputy treasurer of Imperial Chemical Industries, Limited, has been appointed treasurer in succession to MR. J. L. ARMSTRONG, who was recently appointed finance director of the company.

MR. R. KINGSTON, chief assistant blast-furnace manager at the South Bank-on-Tees works of Dorman, Long & Company, Limited, has been appointed blast-furnace manager of the Skinningrove Iron Company, Limited, Saltburn-by-the-Sea (Yorks).

MR. HARRY CLAYTON, joint managing director of C. T. Skelton & Company, Limited, Sheafbank Works, Sheffield, and president of Sheffield Lighter Trades Employers' Association, has left England on a six-month visit to New Zealand, Australia and Ceylon.

MR. KENNETH ALLEN, joint managing director of W. H. Allen, Sons & Company, Limited, engineers, of Bedford, left recently on a six weeks' business tour of South Africa, where his firm has large contracts for plant for water and electricity undertakings.

MR. GEORGE SMAILES, senior representative in spares organization, and Mr. R. J. Gillet, millwright, has received presentations on completing 50 years' service with John Fowler & Company (Leeds), Limited, crawler tractor and locomotive manufacturers, etc.

MR. F. KEMPSON, who was 73 on the day of the annual family dinner and presentation of long-service awards to employees of Josiah Parkes & Sons, Limited, lock makers, etc., of Willenhall (Staffs), last week, received at the ceremony the British Empire Medal, which had been awarded him for 51 years' service with the company.

MR. W. H. PURDIE, a director of Wm. Doxford & Sons, Limited, Sunderland, was re-elected chairman of the National Association of Marine Enginebuilders for 1952/53, at the annual general meeting, held in Edinburgh recently. MR. EWEN H. SMITH, a director of David Rowan & Company, Limited, Glasgow, was re-elected vice-chairman.

MR. EDWARD WHARTON MARVILL, general works superintendent of F. Perkins, Limited, Diesel engine manufacturers, of Peterborough, and a member of Peterborough Engineering Society since 1932, has been elected president of the society. A native of Rochester, where his father was chief designer for Aveling & Porter, Limited, Mr. Marvill joined the Peterborough Company on its formation.

MR. E. R. HOWLETT, a director and general manager, and MR. C. J. RITCHIE, a director and general sales manager of Aveling-Barford, Limited, manufacturers of earth-moving machinery, etc., of Grantham (Lincs), are retiring from the board and from active management of the business at the end of February next year. Mr. Howlett has been connected with the company and its predecessors for 46 years, and Mr. Ritchie for 33 years.

MR. GEOFFREY THOMAS FALLON has succeeded his father, MR. JOHN FALLON, as managing director of the Incandescent Heat Company, Limited, Smethwick. Mr. John Fallon continues as chairman of the parent company and of the Incandescent Group of Companies. MR. CECIL GEORGE PETTIT, a director of the firm for many years, and formerly chief engineer, has been appointed assistant managing director.

Obituary

MR. CHARLES FREDERICK FORMAN, deputy chief inspector of F. Perkins, Limited, Diesel engine manufacturers, of Peterborough, was killed recently in a motor accident.

MR. M. E. SMITH, managing director of Buxton Engineering Company, Limited, Dudley, and formerly technical and sales manager (Midland area) of Wickman, Limited, machine-tool manufacturers, of Coventry, died recently.

MR. WILLIAM EVANS, who died in Birmingham on October 29, aged 67, was consultant to Clifford Motor Components, Limited, of Bordesley Green, of which firm he was co-founder and from the works directorship of which he retired in 1946.

MR. RICHARD NOEL GARROD-THOMAS, who was controller of sulphuric acid during the last war, and general manager of the National Sulphuric Acid Association from its formation just after the first world war until he retired last June, has died at the age of 67.

MR. EDWARD TURTON, formerly governing director of Bromley, Fisher & Turton, Limited, steel and file manufacturers, which was later amalgamated with William Jessop & Sons, Limited, steel manufacturers, etc., of Sheffield, died recently. He was 77. The only son of the late Mr. George Turton, of George Turton, Platts & Company, Limited, drop forgers and stampers, of Sheffield, he retired from business a few years ago.

THE DEATH OCCURRED on October 28 of MR. FRANK CROFT at the age of 74. Mr. Croft was formerly chairman and managing director of Crofts (Engineers), Limited, Bradford, being the eldest of the four sons of the founder of the firm, the late Mr. Frederick Lister Croft. He worked with the firm all his life, becoming chairman and managing director on the death of his father in 1920, and retiring in 1936. Mr. and Mrs. Croft celebrated their golden wedding anniversary in July this year, but Mr. Croft had suffered ill-health for some time. His brother, Mr. Arthur Croft, is the present chairman and managing director of the firm.

The Association of Bronze and Brass Founders propose to make a reprint of the Association's Conditions of Sale as approved at the general meeting on April 27, 1949. Firms requiring supplies of these Conditions should notify the Association's secretaries, Heathcote & Coleman, at 25, Bennetts Hill, Birmingham, 2.

News in Brief

TWO HUNDRED people attended the annual dinner of the Chesterfield and District Foremen's Association.

BELLING & COMPANY have submitted plans to carry out extensions to their foundry at Bridge Works, Southbury Road, Enfield, Middx.

EMCO BRASS MANUFACTURING COMPANY, LIMITED, have had plans drawn up to erect a new brass foundry at Ramsgate Road Estate, Margate, Kent.

DERBY TECHNICAL COLLEGE STUDENTS' ASSOCIATION held their third annual dinner/dance at the Assembly Rooms, Derby. Among the guests was Dr. T. Heap, principal of the College.

CORROSION, LIMITED, announce the introduction of "Glopane Wet," a new type of cold-galvanizing process, specially designed for application to wet iron or steel surfaces or even actually under water.

ALAR, LIMITED, of 3, Albemarle Street, London, W.1, have prepared and despatched to the industry a new data sheet describing the properties and characteristics of the low-expansion alloy to specification B.S. 1490-LM-13.

FORTY-ROOMED MELTHAM HALL was officially opened on Monday as a canteen and social centre for David Brown Tractors, Limited, Meltham, who have leased it from Meltham Urban Council. There will be room for 250 diners.

PAKISTAN has placed orders for another 40 metre-gauge Diesel engines with General Motors Corporation, of the U.S., costing about $8,000,000 (£2,900,000). American concerns recently secured two orders for 40 Diesel engines costing about $10,000,000.

SIXTY-SIX members and visitors attended a meeting of the Engineering Society of Chesterfield College of Technology students' association. A lecture on "Corrosion- and Heat-resisting Steels" was given by Mr. J. A. McWilliam, of Firth Vickers' research laboratories.

WILLIAMS & WOMERSLEY, LIMITED, have celebrated their silver jubilee. The functions included a London cocktail party; a dinner party at Monk Fryston Hall, and a dinner for all the employees at the Mansion House, Leeds, where presentations were made to those having 25 years' or more service with the firm.

WHILE A CRANE was moving a shot-blast plant chamber side at H. Widdop & Company, Limited, diesel-engine builders, Keighley, on October 29, the hook, it is understood, gave way and the chamber fell on to a 53-year-old labourer, seriously injuring his legs and right arm. He died in hospital about three hours later.

MAJOR EDWARD C. PECKHAM, managing director, Metalock (Britain), Limited, returned to London on October 13 from a business visit to Portugal, where he completed arrangements for the formation of a new Metalock Company, Metalock (Portugal), Limited. The new company will be under the direction of Mr. Kenneth Kirkby.

A COMMUNICATION has been received from British Industrial Plastics, Limited, advising formally that their subsidiary company, Beetle Bond, Limited, has now ceased to function as the selling company for Beetle foundry resins, as they themselves are now handling the sale of their own resins. No other change is envisaged.

CUXSON, GERRARD & COMPANY, LIMITED, Oldbury, Birmingham, announce that as from November 1, following the retirement of Mr. G. Cox, who has been with the company for many years, they are represented in the counties of Kent, Surrey, Sussex, Hampshire and Berkshire by Mr. John West, Flat 4, 45, Parkside, Wimbledon Common, London, S.W.19.

LAST FRIDAY, in connection with the scrap collection campaign, the Federation of British Iron and Steel Manufacturers, showed to the Press a film outlining the impressive efforts being made by the armed services. Captain Leighton Davies gave a statement indicating that, whilst some improvement was registered, there was still an urgent need to get back to the scrap dealers every ounce of unwanted metal.

THE HEARING of a £1,000 claim at Dundee Sheriff Court was postponed for two weeks on October 30 with a view to settlement. Angus Nicolson Walker, machine-shop inspector, has raised the action against Urquhart Lindsay & Robertson Orchar, Limited, Blackness Foundry, following an accident in the foundry on or about August 10, 1950. He states that two prefabricated steel beams, each weighing about 6 tons, fell and pinned him to the steelyard.

OWING to a falling off in orders, about 60 employees of Reynolds Light Alloys, Limited, Redditch, were declared redundant on October 31, being given one week's pay in lieu of notice. The firm, which employs over 600 operatives, has been experiencing a slack period for several weeks and talks have been in progress between management and workers' representatives in the hope that the redundancy figure could be kept much lower than it has proved to be.

A COMPLETE NEW FACTORY for mass producing heavy vehicles is being laid out by Albion Motors, Limited, Glasgow. The plant is near their existing works at Scotstoun and is expected to be in production next Spring, employing between 600 and 700 men. This development is taking place at the old Halley works which Albion acquired many years ago. They manufactured small arms there during the war, and since then the premises have been utilized as an export packing department.

MASSEY-HARRIS, LIMITED, which began Scottish production three years ago, and is now employing 1,200 workers, is planning another big expansion in Kilmarnock. They are hoping to start production of combine harvesters for the "small farmer"—an agricultural equivalent of the business man's "baby" car. Officials of the firm said that the extension, which has already begun, will mean employment for about 200 more men. Another 160,000 sq. ft. will be added to the factory, making a total floor space of 700,000 sq. ft.

THE INSTITUTE OF INDUSTRIAL SUPERVISORS has organized a week-end residential course for foremen and supervisors on "The Practice of Management" from December 12 to 14, at Dillington House, Ilminster, Somerset. This course, intended for people carrying supervisory occupations, is based on the idea that management is the job of being responsible for the work of others. It will be conducted throughout by David H. Bramley, head of the Department of Industrial Administration, College of Technology, Birmingham.

SEVEN WORKMEN received burns and damage was caused to a workshop roof by an explosion at the factory of Diecastings, Limited, Balsall Heath, Birmingham, on October 30. The explosion occurred when a caster placed a ladle in a pot of molten aluminium. On the same date an explosion occurred in a foundry at Leek (Staffs), when the "drop" from an outdoor furnace fell into a pool of water at the Moorland Engineering Company's foundry in Newcastle Road. No employees were injured, but windows in the main foundry building were damaged and houses in the vicinity felt the tremor.

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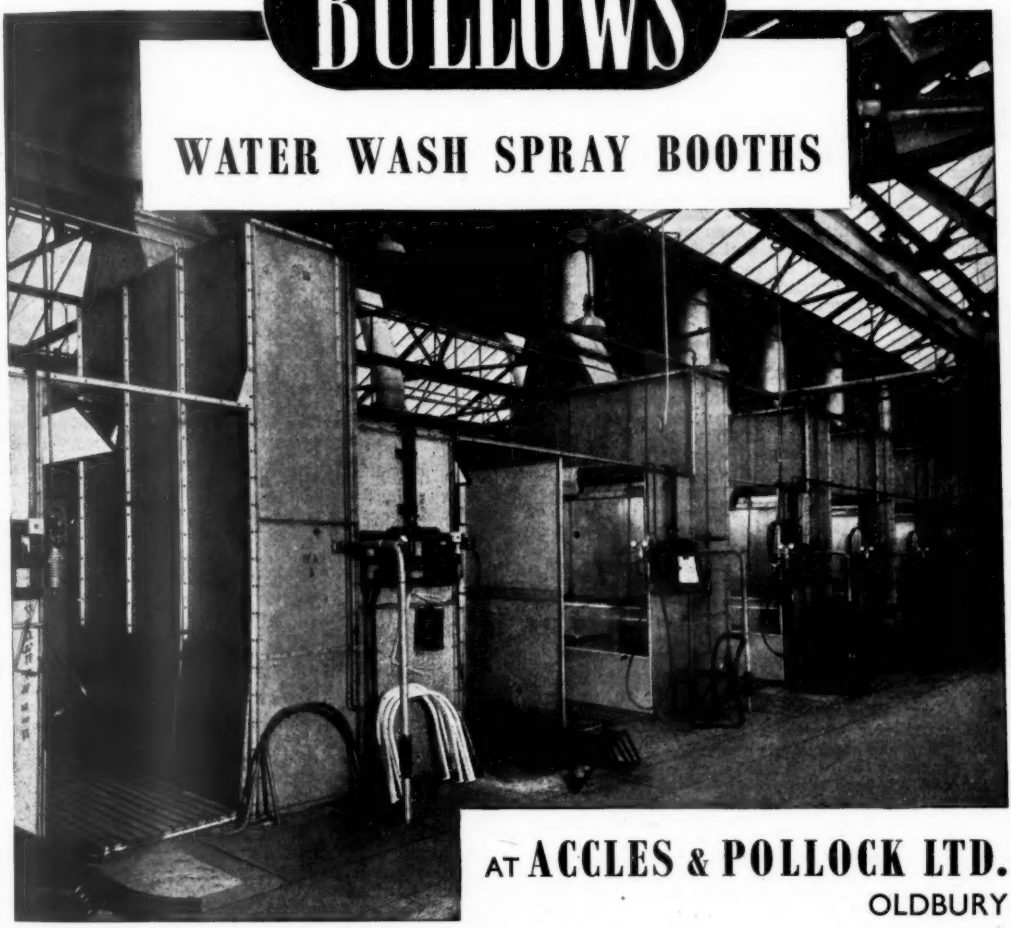

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Raw Material Markets

Iron and Steel

There has been some reaction in the foundry trade to the recent increase in the price of hematite and low-phosphorus pig-iron, because the increase was imposed at a time when the majority of foundries using these grades are feeling the effects of a recession in trade. Some foundries catering for the motor, Diesel engine, tractor, and textile industries, for example, have had a rather severe setback. The foundries naturally contend that the rise in pig-iron prices, necessitating an increase in production costs and the price of castings, has come at an inopportune time. Competition is already very keen on both home and export markets. The light and jobbing foundries are also adversely affected by the recession in trade, but they are not confronted with increased production costs, the high-phosphorus pig-iron which they use mostly being unchanged in price.

Orders for castings show a marked decline and some establishments are faced with the alternative of reducing manpower or the working week. Foundries chiefly affected are those producing castings for household equipment for the home market and some of the jobbing and textile foundries, and the loss of orders for export has reduced their outlets.

The supply of pig-iron is generally sufficient for current needs. The high-phosphorus grade is perhaps the scarcest owing to some furnaces being out of blast for re-lining and repairs. Towards the end of the year outputs should show an appreciable increase. The low- and medium-phosphorus irons and hematite are, in the main, sufficient for current needs. The foundries affected by the increased price of pig-iron are endeavouring to obtain more scrap to offset their costs, and fortunately there is some improvement in scrap supplies.

Foundry coke is coming forward satisfactorily for current needs, with many foundries able to augment their stocks. The allocations for the winter period, which started on Monday last, are based on actual consumption and stock levels at the foundries and they make provision for two weeks' stock of foundry coke at the end of April.

All the re-rollers are fairly well occupied, chiefly on orders for home users for light sections, bars, and strip. There is little sign of any improvement in oversea trade and forward bookings from home buyers are not sufficient fully to replace completed orders. It is reported that consignments of Continental finished steel products have been received in this country, and re-rollers are wondering what effect this will have on their trade, which, about two years ago. suffered considerably in this way.

The sheet re-rollers are very busy. Home buyers take the major proportion of their outputs, and export business is good. Foreign producers have again reduced their prices. but U.K. figures remain lower and more export business could be obtained if outputs permitted. Deliveries of steel semis to all the re-rollers are fairly well maintained.

Non-ferrous Metals

The announcement that the British Government had decided to part with 20,000 tons of Canadian aluminium to the United States on loan has been taken as further proof of the generally easy position of metal supplies. Obviously this large tonnage can be spared without prejudice to the needs of U.K. consumers, who are not now taking anything like as much as they were some months ago. From this country's point of view, the deal means that we shall save a very considerable quantity of dollars, and the metal will be replaced at a later date. Nothing further has been heard of the aluminium market in this country being freed, but, judging by the action taken by the Government in lead and zinc, it would seem that aluminium being in such plentiful supply would enable it to qualify for its freedom. At £166 the price of this metal appears to be unduly high and the trade has hardly got over its surprise at the recent increase of £9.

Among the plentiful metals must also be mentioned zinc, of which the stocks in this country are more than ample and probably still increasing. Last week saw the U.S. quotation brought down to 12¼ cents level, and the Ministry of Materials immediately reduced its price by £8 to £110. Even so the level here is well above Continental offers, which are being made around, or rather below, £90 per ton. Consumers are taking minimum tonnages and will doubtless follow this policy right up to the opening of the market in the New Year.

The lead market has presented a fairly firm front, with moderately good turnovers day by day. The feeling is gaining ground that for the present, at any rate, the bottom of the steep fall which followed on the reopening of the market has been reached. The lead market has certainly acquitted itself well during its first month, and all concerned must feel pleased at the way things have fallen out.

Official prices for refined pig-lead were:—

October—Thursday, £86 15s. to £87. *November*—Friday, £86 5s. to £86 10s.; Monday, £93 to £93 10s.; Tuesday, £91 5s. to £91 10s.; Wednesday, £88 15s. to £89.

January—Thursday, £86 5s. to £86 10s. *February*—Friday, £86 5s. to £86 10s.; Monday, £93 to £93 10s.; Tuesday, £91 to £91 10s.; Wednesday, £88 15s. to £89.

Business in brass and copper scrap is decidedly slow at the present time, no one caring to bring brass forward on account of uncertainties about the outlook for zinc. More interest in copper might have been expected on account of the strike in Rhodesia, but this does not seem to have materialized. In any case, the Ministry of Materials' statement last week that consumers could count on November deliveries in full, but that, should the position not improve; December might be limited to 75 per cent. of the November allocation, has reassured the trade about the situation. Aluminium scrap has been freed from control.

Official tin quotations were as follow:—

Cash—Thursday, £963 to £965; Friday, £958 10s. to £959; Monday, £958 to £960; Tuesday, £959 10s. to £960; Wednesday, £958 to £959.

Three Months—Thursday, £944 to £946; Friday, £940 10s. to £941; Monday, £939 to £940; Tuesday, £940 to £941; Wednesday, £938 to £939 10s.

Tungsten-ore Selling Price

The Ministry of Materials announced that, as from Friday last, its selling prices for tungsten ores of standard 65 per cent. grade and ordinary quality would be:—Wolframite, 432s. 6d.; scheelite, 422s. 6d., both per long ton unit, delivered consumers' works.

Cocktail Party.—Mr. V. Jobson, chairman of Qualcast, Limited, gave a cocktail party last week at the Dorchester Hotel, Park Lane. Amongst the guests were many people prominent in the foundry industry.

F.&M. FERRO-SILICON★ BRIQUETTES

F. & M. SILICON BRIQUETTES

It is well known that the hardness of ordinary cast iron depends to a large degree on the Silicon content of the metal. Silicon acts as a softening agent in cast iron by its action in reducing the amount of combined carbon, which is liberated in the form of free graphite. The presence of ree graphite and a low combined carbon content contribute towards easy machineability.

In these days of restricted supplies of good machinery scrap iron and also of pig irons with a wide range in chemical composition, F. & M. Ferro Silicon Briquettes provide a practical and economical means of increasing the amount of Silicon in a cast iron. The necessary number of Briquettes is added to the charge in the Cupola and all the Silicon contained in the Briquettes passes into the molten metal with only a negligible loss *because the element is protected during its progress through the oxidising zone.*

An important function of **F. & M. Ferro Silicon Briquettes** is in the production of dense iron castings with high tensile strength. The foundryman usually ensures sufficient "softness" in his castings by using a pig iron with 3 to 4 per cent. Silicon. Such pig irons are frequently coarse-grained with large graphite flakes and, when used in ordinary cupola mixtures of pig and scrap iron, are apt to give rise to castings containing large graphitic flakes. This coarse-grained structure, which is particularly developed in the thicker parts of the section, results in an iron of comparatively low tensile strength.

By using pig irons of medium Silicon content (2 to 2·5 per cent. Silicon) which possesses a denser structure owing to their smaller graphite flakes, and increasing the Silicon content of the metal by an appropriate addition of **F. & M. Ferro Silicon Briquettes** to the cupola mixture, an iron with much smaller graphite flakes, and therefore, with a denser structure, is produced. At the same time, the metal is readily machineable, although it is denser and stronger, ***as the composition of the metal remains unaltered from that obtained by the use of higher Silicon coarse-grained pig irons.***

Technical advice for any special working conditions gladly given on request

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered, unless otherwise stated)

November 5, 1952

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £13 1s. 6d.; Birmingham, £12 15s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £16 8s., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £15 5s. 9d.

Scotch Iron.—No. 3 foundry, £15 19s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £17 14s. 6d.; South Zone, £17 17s.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £18 14s. 6d.; South Zone, £18 17s.

Cold Blast.—South Staffs, £18 2s.

Hematite.—Si up to 2½ per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. Coast and N.-W. Coast of England, £16 2s.; Scotland (Scotch iron), £16 8s. 6d.; Sheffield, £17 3s.; Birmingham, £17 9s. 6d.; Wales (Welsh iron), £16 8s. 6d.

Basic Pig-Iron.—£13 19s. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered.)

Ferro-silicon (6-ton lots).—40/55 per cent., £57 10s., basis 45% Si, scale 21s. 6d. per unit; 70/84 per cent., £86, basis 75% Si, scale 23s. per unit.

Ferro-vanadium.—50/60 per cent., 22s. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £204; ditto, copper-free, £212.

Ferro-tungsten.—80/85 per cent., 27s. 6d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 30s. 8d. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £85 4s., basis 60% Cr, scale 28s. 3d. per unit; 6/8 per cent. C, £80 17s., basis 60% Cr, scale 26s. 9d. per unit; max. 2 per cent. C, 2s. per lb. Cr; max. 1 per cent. C, 2s. 2½d. per lb. Cr; max. 0.15 per cent. C, 2s. 3½d. per lb. Cr; max. 0.10 per cent. C, 2s. 3¾d. per lb. Cr; max. 0.06 per cent. C, 2s. 4d. per lb. Cr.

Cobalt.—98/99 per cent., 20s. per lb.

Metallic Chromium.—98/99 per cent., 6s. 5d. to 6s. 9d. per lb.

Ferro-manganese (blast-furnace). — 78 per cent., £49 0s. 8d.

Metallic Manganese.—93/95 per cent., carbon-free, £262 per ton.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 4s. 6d.; tested, 0.08 to 0.25 per cent. C (100-ton lots), £25 14s. 6d.; hard (0.42 to 0.60 per cent. C), £27 12s.; silico-manganese, £33 8s.; free-cutting, £28 8s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £31 9s.; case-hardening, £31 17s.; silico-manganese, £34 9s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 8s.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 8s.; acid, up to 0.25 per cent. C, £31 17s.

Sheet and Tinplate Bars.—£25 3s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £29 14s.; boiler plates (N.-E. Coast), £31 1s. 6d.; chequer plates (N.-E. Coast), £31 3s.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £27 17s.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £31 15s. 6d.; flats, 5 in. wide and under, £31 15s. 6d.; hoop and strip, £32 10s. 6d.; black sheets, 17/20 g., £41 12s. 6d.; galvanized corrugated sheets, 24 g., £53 3s.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £50 18s. 3d.; nickel-chrome, £71 7s. 9d.; nickel-chrome-molybdenum, £79 2s. 6d.

Tinplates.—57s. 1½d. per basis box.

NON-FERROUS METALS

Copper.—Electrolytic, £285; high-grade fire-refined, £284 10s.; fire-refined of not less than 99.7 per cent., £284; ditto, 99.2 per cent., £283 10s.; black hot-rolled wire rods, £294 12s. 6d.

Tin.—Cash, £958 to £95[illegible]ree months, £938 to £939 10s.; settlement, £958.

Zinc.—G.O.B. (foreign) (duty paid), £110; ditto (domestic), £110; "Prime Western," £110; electrolytic, £114; not less than 99.99 per cent., £116.

Lead.—Refined pig-lead: November, £88 15s. to £89; February, £88 15s. to £89.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £130 15s.; rolled zinc (boiler plates), all English destinations, £128 15s.; zinc oxide (Red Seal), d/d buyers' premises, £136.

Other Metals.—Aluminium, ingots, £166; magnesium, ingots, 2s. 10½d. per lb.; antimony, English, 99 per cent., £225; quicksilver, ex warehouse, £64 10s. to £64 15s.; nickel, £454.

Brass.—Solid-drawn tubes, 26¾d. per lb.; rods, drawn, 36¾d.; sheets to 10 w.g., 31⅝d.; wire, 32⅝d.; rolled metal, 29⅝d.

Copper Tubes, etc.—Solid-drawn tubes, 32⅝d. per lb; wire, 317s. 9d. per cwt. basis; 20 s.w.g., 346s. 3d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £196 to £218; BS. 1400—LG3—1 (86/7/5/2), £215 to £238; BS. 1400—G1—1 (88/10/2), £345 to £375; Admiralty GM (88/10/2), virgin quality, £352 to £380 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £355 to £385; L.P.Bl, £250 to £275 per ton.

Phosphor Bronze.—Strip, 44d. per lb.; sheets to 10 w.g., 46½d.; wire, 49½d.; rods, 44½d.; tubes, 42⅝d.; chill cast bars: solids 4s. 4d., cored 4s. 5d. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 2s. 9d. per lb. (7%) to 3s. 10d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 3s. 3d. (7%) to 4s. 4d. (30%); to 12 in. wide × .056, 3s. 3½d. to 4s. 4½d.; to 25 in. wide × .056, 3s. 5½d. to 4s. 6½d. Spoon and fork metal, unsheared, 3s. to 4s. 1d. Wire, 10g., in coils, 3s. 9½d. (10%) to 4s. 10d. (30%). Special quality turning rod, 10%, 3s. 8½d.; 15%, 4s. 1⅝d.; 18%, 4s. 6½d. All prices are net.